



Bird City Wisconsin

*Making our communities healthy for birds ...
and people*

1111 E. Brown Deer Road
Bayside, WI 53217



January 2, 2017

Chris Abele
Milwaukee County Executive
Milwaukee County Courthouse
901 N. 9th Street, Room 306
Milwaukee, WI 53233

Milwaukee County Board of Supervisors
Milwaukee County Courthouse
901 N. 9th Street, Room 201
Milwaukee, WI 53233

City of Wauwatosa
7725 W. North Avenue
Wauwatosa, WI 53213

RE: Potential development of Sanctuary Woods/East Woods at the Milwaukee County Grounds

Dear Citizens of Milwaukee,

On behalf of Bird City Wisconsin, I am writing to ask that you resist the temptation to develop any of the remaining wildlife habitat at the Milwaukee County Grounds. Once developed, urban wildlife habitat is lost forever – please do not make the mistake of trading one of Milwaukee County’s natural jewels for a little bit of tax revenue from new construction that looks like everything else in the area. It is important to draw a distinction between remnant, undeveloped, wild areas like the County Grounds that have immense value for wildlife, and the layperson’s definition of greenspace which includes manicured grass, athletic areas, and other zones that are significantly less valuable as habitat for migrating and breeding animals. Developing the County Grounds will be a serious blow to Milwaukee County’s wildlife and to the animals that rely on being able to rest and refuel at the County Grounds during their thousands-of-miles long annual migrations.

Bird City Wisconsin is a community conservation and education organization – we provide highly visible public recognition for communities that work to make themselves healthy for birds ... and people. To become a Bird City, a community must meet several criteria spread over five categories, the first of which is habitat protection and creation. Bird City recognizes two levels of achievement, basic Bird City status and High Flyer status, with the latter reserved for communities that truly go above and beyond in their conservation and education efforts. **Milwaukee County is a member of the elite High Flyers**, putting the County in a small group of Wisconsin communities that place the protection of urban wildlife high on their list of priorities. It is my sincere hope that the County keeps in mind that it is a leader in urban conservation as it decides the fate of the County Grounds.

Natural areas are important to humans for a variety of reasons. To begin, they are beautiful and people highly value scenic landscapes. Urban wildlife habitat has special value because people also have a subconscious desire to be close to nature – after all, there is a reason we have pets, indoor plants, enjoy

A photograph of a forest with a stone wall and a path, serving as a background for the text. The scene is a dense forest with many trees and green foliage. A stone wall runs across the middle ground, and a path is visible behind it. Sunlight filters through the trees on the left side.

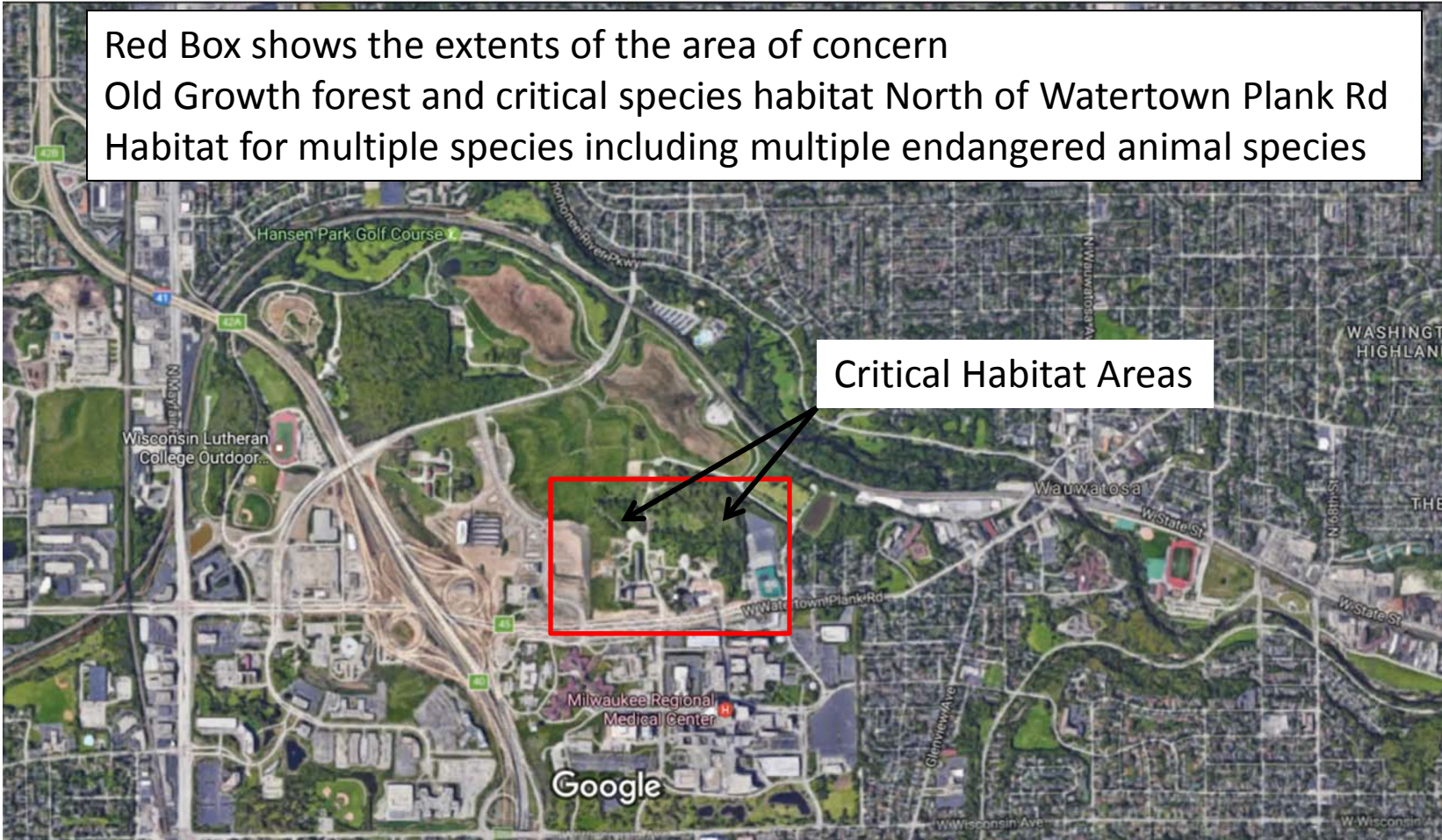
County Grounds Exhibit

Wauwatosa, WI
January 2017

Overview – area of concern

Red Box shows the extents of the area of concern
Old Growth forest and critical species habitat North of Watertown Plank Rd
Habitat for multiple species including multiple endangered animal species

Critical Habitat Areas



1000 ft

Framework Plan from Graef

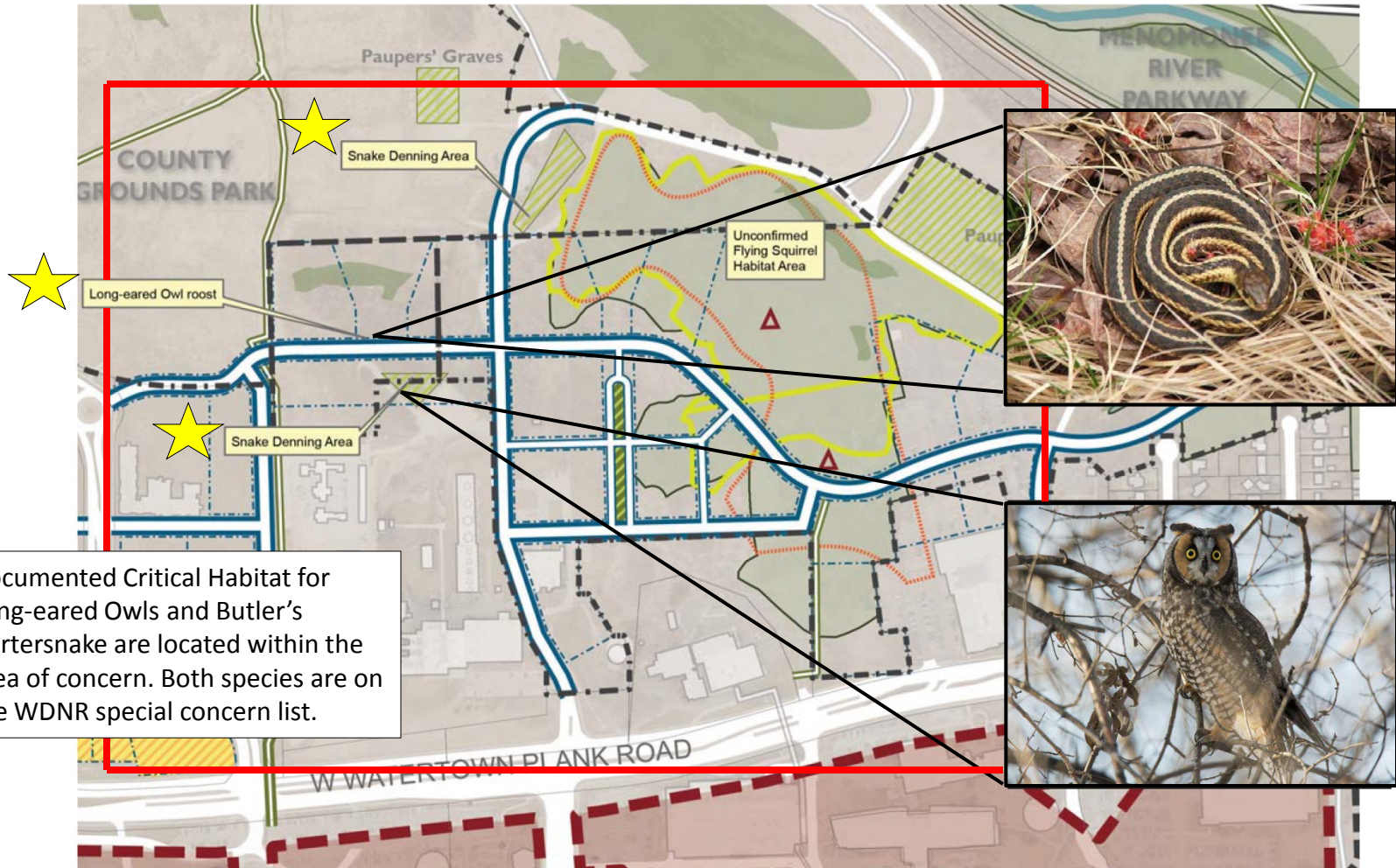


Proposed Development



Habitat Encroachment

FRAMEWORK PLAN - HABITAT, LANDMARKS & ENVIRONMENTAL CORRIDORS

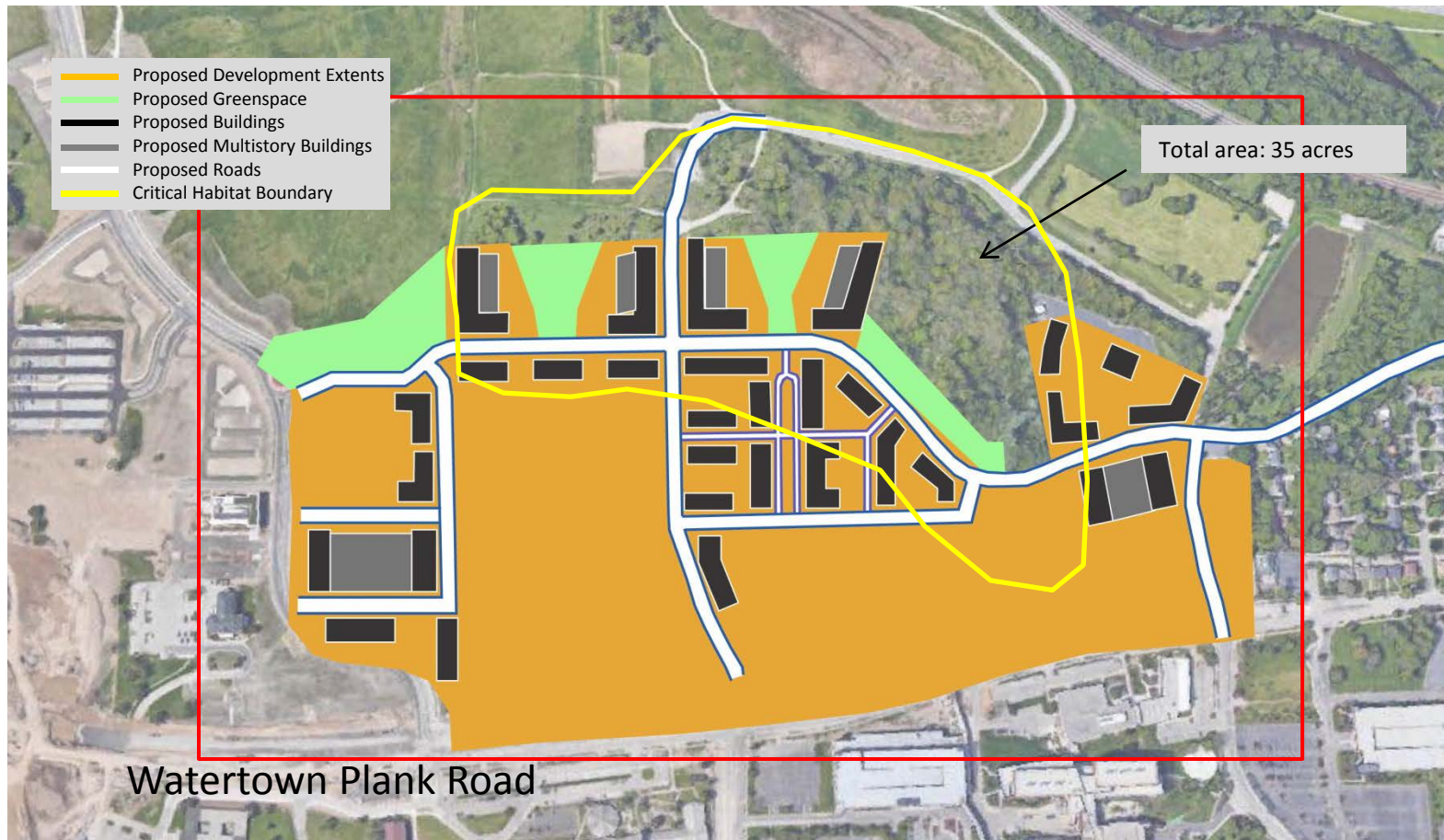


Documented Critical Habitat for Long-eared Owls and Butler's Gartersnake are located within the area of concern. Both species are on the WDNR special concern list.

— Area of Concern

Close up of Encroachment

- 64.3% of the Critical Habitat Area is being removed for development
- Total of 980,300 sq ft (22.5 acres) of roads and buildings inside the perimeter of the Critical Habitat



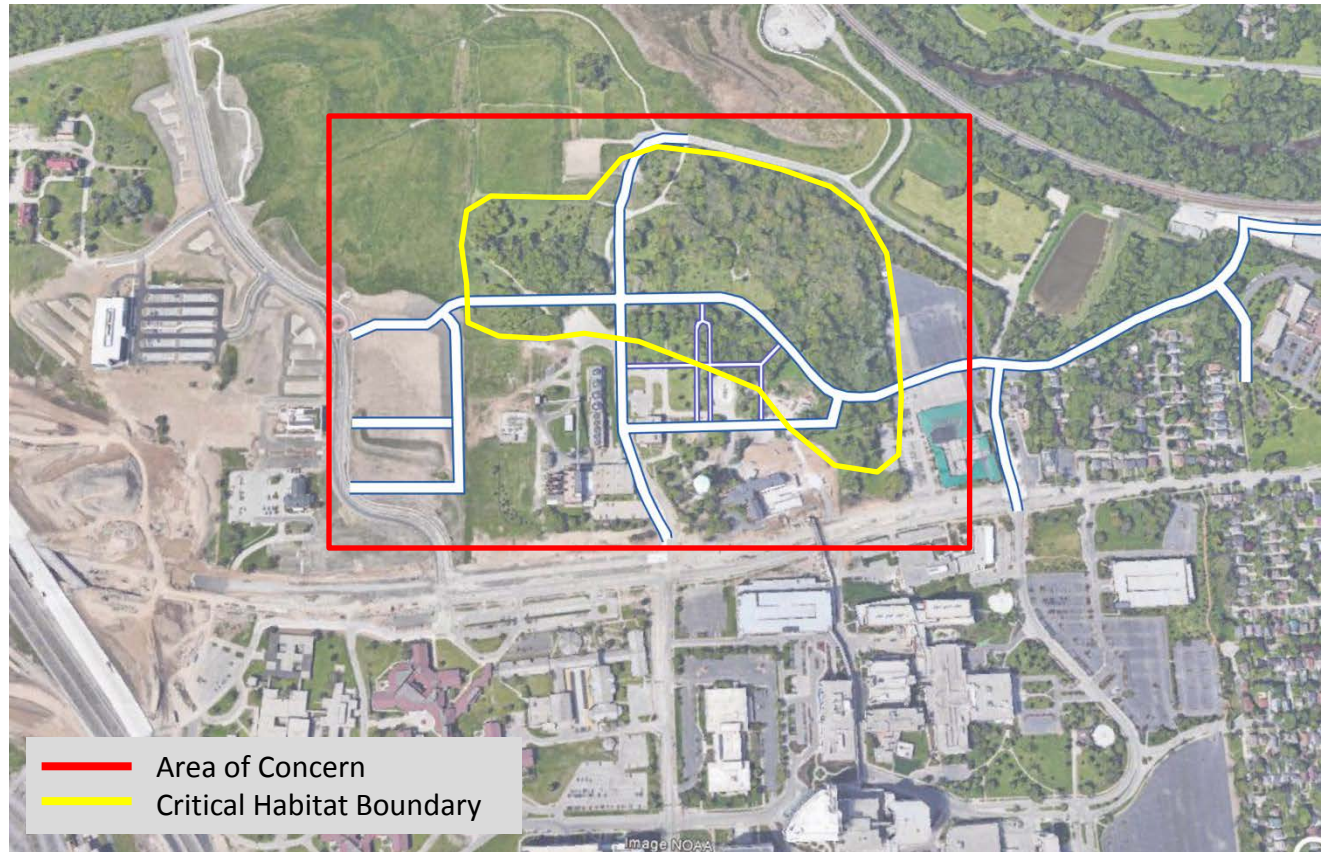
Overlay of streets

Proposed 288,190 sq ft (6.62 acres) of new road construction



Proposed Roadways Runoff

	Average Rainfall Event (1")	Average Annual Rainfall (34.5")
# of Gallons	178,920	6,197,526



*Calculations based off the square footage of proposed roadway construction within Area of Concern

*Does not include any paved sidewalks

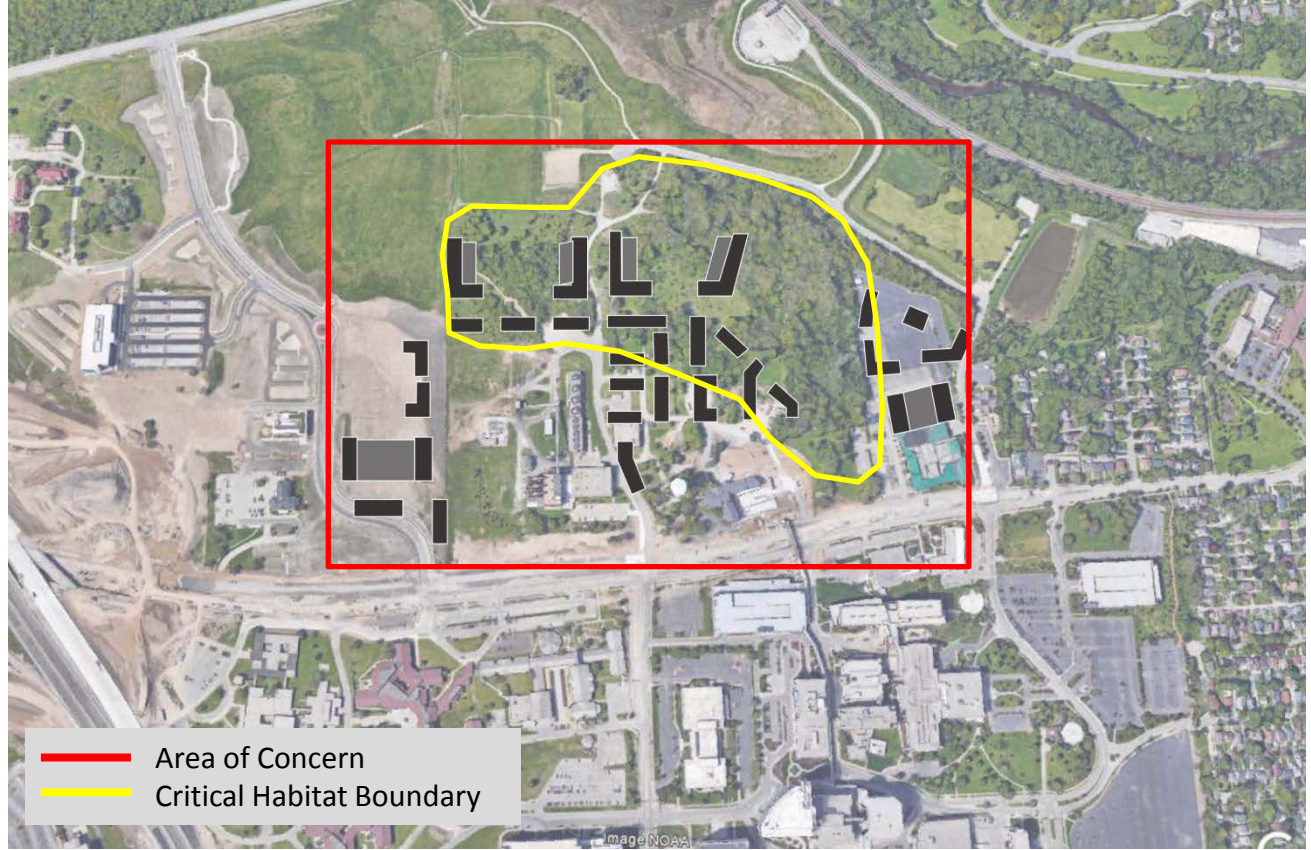
Overlay of Buildings

Proposed 524,528 sq ft (12.04 acres) of new building footprint



Proposed Buildings Runoff		
	Average Rainfall Event (1")	Average Annual Rainfall (34.5")
# of Gallons	326,956	11,279,975

*Calculations based off the proposed square footage of multi-story development within Area of Concern
 *Does not include any parking lot surfaces or paved walkways



MEMORANDUM

Date: March 13, 2017 (via e-mail)

To: Barb Agnew, Environmental Impact Assessment Committee for the Northeast Quadrant of the County Grounds

From: Gary S. Casper, Ph.D.

Subject: Potential environmental impacts from the proposed development of “Sanctuary Woods” as part of the Wauwatosa Life Sciences District

RE: This memorandum was prepared for the Milwaukee County Board of Supervisors, as requested in Board Resolution 16-532, to assist with assessing potential wildlife habitat and population impacts of the proposed development of “Sanctuary Woods” as part of the Wauwatosa Life Sciences District (per the “Wauwatosa Life Sciences District: 2016 Master Plan”, January 12, 2017 DRAFT).

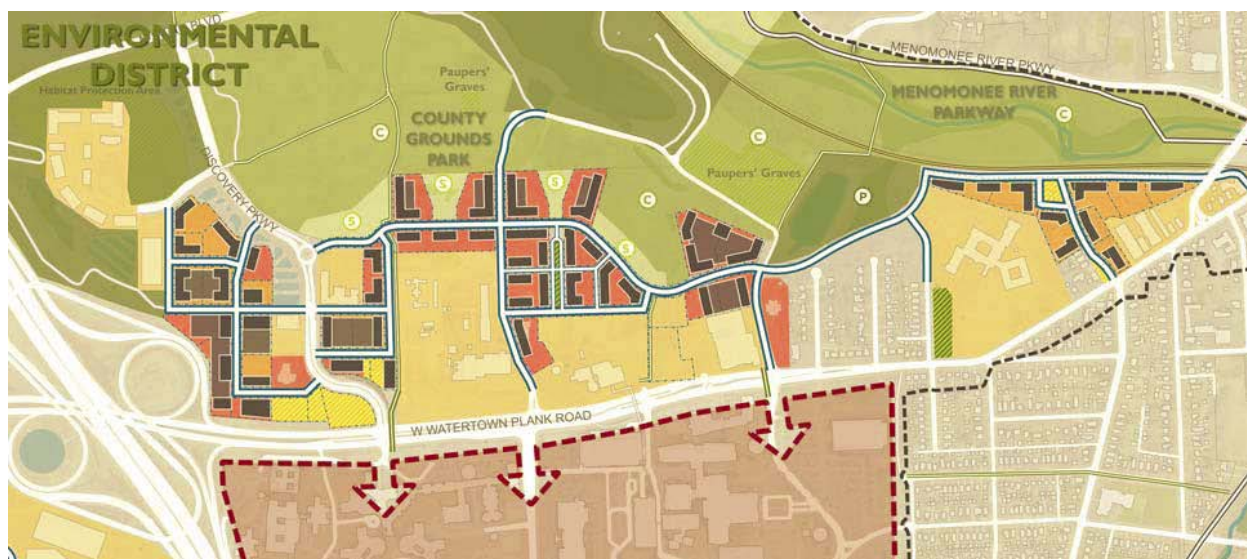


Figure 1: Proposed development in the Sanctuary Woods area of the Milwaukee County Grounds. (Source: Wauwatosa Life Sciences District: 2016 Master Plan (January 12, 2017 DRAFT))

Potential Environmental Impacts from the Proposed Development of “Sanctuary Woods” as part of the Wauwatosa Life Sciences District

Executive Summary

This memorandum provides recommendations for performing a professional assessment of potential impacts to wildlife populations and habitats when considering any proposed developments in the Milwaukee County Grounds area, including Sanctuary Woods. In this region wildlife populations and habitats have been designated as federally "impaired" by the Milwaukee Estuary Area of Concern (MEAOC) program. The area supports protected species and their habitats. The MEAOC program may provide funding to address these impairments in the future, which could contribute to the development of the envisioned "Life Sciences District". The methods outlined here provide a means to discover what impacts might occur, how to address mitigation, and how to credibly balance ecological with social goals. Shortcomings of the existing approach are addressed, and improved methods provided with examples. In addition, a rich trove of data, collected and vetted over the past three years by the Great Lakes program of the U.S. Environmental Protection Agency, is mined to provide the empirical evidence needed to properly assess environmental impacts to wildlife species and their habitats. Rare species and habitats present are reviewed. The availability of these data and methods provide a unique opportunity for planning to proceed with confidence in outcomes.

Southern Flying Squirrel, a rare species in the region selected for conservation action.



1. Introduction

To assist with assessing potential wildlife habitat and population impacts from the proposed development of “Sanctuary Woods” (per the “Wauwatosa Life Sciences District: 2016 Master Plan”, January 12, 2017 DRAFT), conservation assessment methods developed for the Milwaukee Estuary Area of Concern, and Ozaukee County Planning and Parks, were applied. Since this is only a memorandum, not a fully developed professional assessment, the focus is on appropriate methods, while providing available data for the project site that has been collected by other studies to date. As will be shown, ecological assessments must be performed within the context of their surrounding landscape.

The proposed development footprint (Figure 1) can be fitted to a landscape scale shown in Figure 2. Habitat supports wildlife populations irrespective of parcel ownership, based on existing conditions. The methods and data provided below are intended to begin the process of open discussion on preserving or enhancing these natural resources (species habitat and populations), by understanding what species can be supported on the overall landscape, then drilling down to how changes within any particular parcel might affect overall habitat suitability. This process also allows for open acknowledgement of which natural resources will not be preserved. Because of the complexity of predicting impacts of development to wildlife populations, open acknowledgement of an inability to support species is not common. However, planners must be very careful not to overstate benefits by inappropriately ignoring probable impacts, or by making overbroad claims that resources are being preserved when cumulative or indirect impacts indicate otherwise. For example, preserving part of an old growth forest may avoid cutting down a particular grove, but if the overall extent of the forest is reduced, edge effect will change the character and microclimate of the forest, and many wildflowers, birds, insects, mammals, and amphibians are likely to disappear, and this must be openly acknowledged by planners to maintain public trust and confidence. Assessment of what wildlife species are likely to be or not be preserved is possible by coupling well known ecological processes with species natural history and habitat requirements. This allows the community to balance natural resource preservation against potentially conflicting social objectives in an open and informed manner. It is fairly easy to ask the community to accept that children will not be able to see ducks or frogs when a wetland is proposed to be filled, but the public often does not intuitively realize that butterflies or meadowlarks will disappear if those species particular habitats are not preserved. These more subtle effects can be discovered and communicated by our methodology, leading to more informed decision making, thereby avoiding a replay of the Tragedy of the Commons. It is often fairly easy to balance social and biological objectives in planning to achieve good outcomes for the health and well being of the community, but only if thorough background research is performed and professional ecological standards applied.



Figure 2: Green space represents approximate existing wildlife habitat. (Source: Wauwatosa Life Sciences District: 2016 Master Plan (January 12, 2017 DRAFT))

1.1 Avoiding Common Pitfalls

--don't paint your cabinets before you know what color your walls will be--

A common deficiency in conservation planning is to limit the spatial scope of assessment, usually to a political boundary. This is particularly problematic when assessing mobile natural resources such as most animal life. By avoiding such spatial limits, potential impacts to animals whose home ranges and life cycles extend beyond the project boundaries can be discovered and addressed, and should be a component of planning. Often a project boundary is only a part of a critical habitat component for a wildlife population, and rare species can disappear regionally simply because they were not addressed in local planning, and "piecemealed to death." Spatially limited assessments can even be considered invalid by the normal standards and practices of the conservation biology profession. Imagine asking an auto mechanic to perform a safety check, but to limit the check to only the rear drive train. Would the car be considered safe?

A second common mistake is to assume that plant community assessments address animal community needs. There is often poor correlation or spatial overlap between critical habitat needs for plants vs. animals. For example, in a recent assessment for Ozaukee County, we found that combining the Natural Areas, Critical Species Habitat, and Critical Aquatic Habitat layers from regional planning, which are based mostly on plant community assessments (Southeastern Wisconsin Regional Planning Commission 1997, 2010), accounted for only 12% of the rare wildlife occurrences in the county (Struck et al. 2015). This obviously has implications for conservation planning, and planners must recognize that preserving viable wildlife populations requires a more comprehensive approach. Similar discordance is expected in Milwaukee County, where more than 40% of the biodiversity in the county has already been lost (Casper 2008, Leitner et al. 2008).

Finally, a third pervasive problem is the typically poor data coverage and quality available for assessing wildlife. For example, many regulatory reviews restrict data searches to one source — the Natural Heritage Inventory (NHI) database managed by the Wisconsin DNR. Like any single source, this database is incomplete, and requires expert vetting to address Type I and Type II errors. Moreover, its conservation ranking system is performed at a statewide scale, which is poorly suited to understanding conservation issues at regional, county, or local scales. Planners should understand that as a database developed primarily for regulatory review, the use of the NHI for conservation planning is predictably limited, and that these two objectives (regulatory review vs. conservation planning) are not mutually exclusive nor inclusive. For example, in Ozaukee County, 55% of species considered to be of county-scale conservation concern are not state listed (Struck et al. 2015). This difference is only slightly less when considering Species of Greatest Conservation Need in the State Wildlife Action Plan (58%; Struck et al. 2015). Moreover, critical habitat needs for wildlife species are often poorly known, requiring extensive literature searches and expert advice to properly address. Imagine an engineer tasked to design a safe bridge, but who lacks knowledge of what the span length should be, the tensile strength of the materials to be used, and how materials will degrade with freeze-thaw cycles. That is the level of baseline knowledge deficiency a conservation biologist must often deal with, researching these issues case by case to perform due diligence.

Most often lack of attention to these issues is simply the result of planning teams not having conservation biologists on staff, and having limited access to sound advice and data. Principled planning avoids these mistakes by taking a measured, open, and comprehensive approach, with expert advice input where needed. In the current context, the Master Plan has identified preservation and enhancement of environmental resources as a high priority, describing a large environmental area as comprising the most critical district in the Plan. This objective requires that a spatially broad review encompasses the full

habitat needs for supporting viable wildlife populations. To do anything less would ignore fundamental principles of population biology and ecology, and result in wasted effort and expense preserving portions of habitat that may not actually support the species intended to live there.

1.2 Assessment Approach

The Milwaukee County Grounds contains several verified populations of sensitive wildlife species as well as critical species habitat features. The habitat proposed to be impacted by the proposed construction (Figure 1) falls within the federally designated Milwaukee Estuary Area of Concern (AOC; see <http://dnr.wi.gov/topic/greatlakes/milwaukee.html> and <https://www.epa.gov/milwaukee-estuary-aoc>). For this memorandum, data and products under development for the Milwaukee Estuary AOC were utilized, which identified Beneficial Use Impairments (BUI) of loss and degradation of fish and wildlife habitat and populations. In order to address the federal delisting of these BUIs, the Milwaukee County Department of Parks, Recreation & Culture (DPRC) and University of Wisconsin-Milwaukee Field Station (UWMFS) have collected baseline data on historical and existing wildlife populations and habitat conditions throughout the AOC, and, in cooperation with the Fish and Wildlife Technical Team for the AOC (administered by the Wisconsin DNR Great Lakes Office), have identified Species of Local Conservation Interest (SLCI) that are considered to be impaired and may be eligible for recovery actions. On the Milwaukee County Grounds critical species habitats have been confirmed within the proposed development site, including snake denning areas, grassland nesting bird habitat, forested avian roosting and foraging habitat, migratory stopover habitat, and ephemeral wetlands. Additionally, state-listed species and Species of Local Conservation Interest have been confirmed on the site and are described below. Preservation of these key resources should be of high priority. Impacts to these species and their associated habitats can be evaluated following a "first do no harm" principle, which first avoids impacts through plan modifications, and then mitigates any necessary impacts based on critical habitat needs of the affected species.

The ongoing Milwaukee Estuary AOC study addresses fish and wildlife habitat and population impairments by collecting and vetting wildlife occurrence data, and developing species checklists that identify which species are of conservation concern. Then the spatial extent of these species' existing habitats can be assessed with an eye towards better defining the impairments, and recommending how and where these impairments can be remediated through habitat and population projects, ultimately leading to delisting of the BUIs. The AOC team therefore has acquired comprehensive knowledge of species and habitats that could be addressed in planning for the Milwaukee County Grounds, including that area commonly referred to as Sanctuary Woods.

It is important to understand that this memorandum is not a comprehensive study such as would normally be included in a Master Plan, but merely guidance on issues that should be addressed in conservation planning. Each issue will likely need further research and development to inform planning specifications in detail. Moreover, the Milwaukee Estuary AOC study assessments are limited to the following species groups: all vertebrates, dragonflies and damselflies, primary burrowing crayfish, and mussels. Two additional species groups which should be assessed are mentioned below (butterflies and moths, and pollinators), as well as two physical environmental issues particular germane to urban planning (noise and light pollution), and some unique habitat issues. Notably, this memo does not address plant communities, for which use of SEWRPC data is recommended.

Finally, any comprehensive plan should give attention to the social health and well being of its residents, including the benefits to be derived from integrating green space and functional natural communities into neighborhoods, in a manner where both children and adults can reap the benefits. Something as simple as children having the ability to catch frogs, or adults observing colorful birds nesting, in their neighborhood rather than miles away in preserves they rarely visit, has substantial benefits to health and well being, making communities attractive and vibrant. The benefits of interacting with nature are well documented

and experts in this subject area can be engaged (e.g., Louv 2005). Without explicit and comprehensive planning, most communities will lose these benefits by passively allowing the "Tragedy of the Commons" to proceed (see https://en.wikipedia.org/wiki/Tragedy_of_the_commons).

1.3 Assessment Conceptual Framework

The conceptual framework for the Milwaukee Estuary AOC study addresses the problem of beneficial use impairments by recognizing how natural resources and their recovery potential are constrained. This framework is useful for any conservation planning. Two sets of constraints apply to any successful wildlife conservation program, a paradigm developed by Dodd and Seigel (Dodd and Seigel 1991, Seigel and Dodd 2000, Dodd 2001).

Biological Constraints are the immutable requirements for a species survival imposed by its adaptation to the environment over long evolutionary periods (thousands to millions of years). These include food preferences, dietary needs, specific habitat requirements, social behaviors, environmental tolerance limits (i.e., temperature), predator tolerance, life table parameters, and more. If a species requires a certain type and amount of habitat to support a viable population, or a specific diet, no amount of human desire will change those requirements. We cannot simply tell the eagle to eat wheat, or the fish to live on land.

Social Constraints describe the limits within which human activities are able to perform. These constraints include finances, manpower, public support, political support, habitat availability, logistics, and many other factors associated with implementing conservation programs. While important, these constraints are usually flexible, sometimes wildly so based on human desire to prioritize resources. They are always more flexible than the *Biological Constraints*.

If the *Biological Constraints* are breached, then regardless of our best intentions the conservation program will fail. These constraints are not "negotiable", being set by evolution and the physical limits of the species. Moreover, if the *Social Constraints* are inadequate, or are used to override or compromise the *Biological Constraints*, then the program will fail, no matter how noble the intentions of the human participants.

Recognizing these basic constraints is vitally important to successful wildlife conservation, yet they are easily lost when forced to make decisions in the imperfect real world. The ability to recognize where these constraints cannot be met is just as important as the ability to adhere to them when they can be met, in order to direct scarce resources to successful projects. Conservation biologists must often make informed decisions on the limits of the *Biological Constraints* where they are not known with firm certainty. This is common with rare species where life history tables have not been developed and funding for basic research is scarce for delineating parameters such as minimum viable population size or critical habitat needs. This makes work challenging for gaining public acceptance when conservative plans must be implemented despite a lack of comprehensive data. For this reason, many conservation plans rely upon surrogates, and umbrella or focal species concepts, for achieving and communicating the *Biological Constraints* to conservation for poorly studied species. Focal species concepts are being utilized in the Milwaukee Estuary AOC study, and methods and definitions are available.

2. Potential Impact Assessment

2.1 Species of Local Conservation Interest (SLCI)

This local conservation ranking system developed for the Milwaukee Estuary AOC study identifies species that meet criteria for Species of Local Conservation Interest (SLCI), which are recommended for attention in local conservation planning. The lists were developed initially from a review of species occurrence and status information, then vetted by local and regional species experts. As noted above, this is necessary because conservation planning on this geographic scale is not well served by using statewide conservation ranks. SLCI are species that are at least one of the following: a) listed as either state or federally Endangered, Threatened, or Special Concern; b) listed as Species of Greatest Conservation Need in the State Wildlife Action Plan; c) considered to be locally rare or declining (by regional species expert groups and this status supported by the available empirical data); or d) are of social value to stakeholders and considered to be desirable to the community.

For the Milwaukee County Grounds, the following species have been defined as SLCI (note this list will be reviewed again in late 2017) and are known to occur, or have the potential to occur with reasonable habitat restoration (* = species with reliable recent records). For the purpose of this memorandum, the extent of the area considered in this context is roughly that shown in Figure 2 above. While SLCI for this area are called out below, the full Species Checklists for the Milwaukee Estuary AOC study list every species known for each group, along with their status rankings and critical habitat requirements, and are used to select Focal Species. These checklists are currently in draft form and circulating among stakeholders and experts, and will be updated at the end of this year. They provides a more comprehensive understanding of full suites of species that are associated with habitat types that may be part of a particular project. Note that the proposed project will affect several habitat types, which these species depend upon to varying extents. The habitats impacted include grassland, shrub, forest edge, mature closed canopy hardwood forest, and several wetland types. All habitats are in varying existing states of degradation, but nevertheless currently support, or are likely to support with appropriate management, the following SLCI.

Mammals:

American Mink, Big Brown Bat, Common Gray Fox, Coyote*, Eastern Fox Squirrel, Eastern Red Bat, Ermine, Hoary Bat, Least Weasel, Little Brown Bat, Northern Long-eared Bat, Silver-haired Bat, and Southern Flying Squirrel*.

Breeding Birds:

American Redstart*, Bobolink*, Brown Thrasher, Chimney Swift*, Common Nighthawk, Dickcissel*, Eastern Meadowlark*, Field Sparrow*, Grasshopper Sparrow, Great Blue Heron*, Henslow's Sparrow* (2012, not since), Least Flycatcher* (2012, not since), Long-eared Owl* (wintering), Peregrine Falcon*, Sora*, Virginia Rail, Willow Flycatcher*, Wood Thrush*, and Yellow-billed Cuckoo.

Amphibians & Reptiles:

Blue-spotted Salamander, Boreal Chorus Frog, Butler's Gartersnake *, Central Newt , Common Gartersnake*, Eastern Milksnake*, Eastern Tiger Salamander, Gray Treefrog*, Green Frog*, Midland Brownsnake*, Northern Leopard Frog*, Spring Peeper, and Wood Frog.

Fishes:

Not applicable unless in-stream Menomonee River is considered in planning.

Dragonflies & Damselflies:

During the course of this study, it became clear that SLCI cannot be designated for this group, owing to a lack of status information. We found many species considered to be new and rare in the AOC, reflecting a lack of prior survey effort. Therefore, the AOC study will be publishing a list of known species for the region, which can be used for future assessments of how species occurrence might change. Meanwhile, odonate critical habitat needs, while varied, can be addressed on a species group basis. We have to date documented the following species at Milwaukee County Grounds: Autumn Meadowhawk, Band-Winged Meadowhawk, Black Saddlebags, Blue Dasher, Calico Pennant, Common Baskettail, Common Green Darner, Dot-Tailed Whiteface, Eastern Forktail, Eastern Pondhawk, Familiar Bluet, Marsh Bluet, Northern Spreadwing, Ruby Meadowhawk, Sweetflag Spreadwing, Tule Bluet, Twelve-Spotted Skimmer, Wandering Glider, White-Faced Meadowhawk, and Widow Skimmer.

Primary Burrowing Crayfish:

Prairie Crayfish

Mussels:

Not applicable unless in-stream Menomonee River is considered in planning.

2.2 Cumulative and Off-site Impacts

The concepts of home range, habitat patch size, habitat fragmentation, and habitat connectivity are recommended to be addressed. As shown in Figure 2, habitats are currently fairly well connected, but some disconnections could be addressed, and further fragmentation should be avoided. It should be recognized that impacts to any part of an animal's home range will affect the entire population, which often ranges beyond project boundaries. To illustrate, the Southern Flying Squirrel is a SLCI, with one of four known populations in the AOC present at Milwaukee County Grounds. Individuals have been observed and photographed at Milwaukee County Grounds, but the mature forest patches with mast trees which they depend upon as critical habitat (including Sanctuary Woods) are fragmented, and squirrels must move from one to the other across hostile terrain where they are more exposed to predators (e.g., crossing Swan Blvd., or open grassland areas). Therefore, a reduction in the size of Sanctuary Woods, or further compromising its connectivity to other forested areas, would have a cumulative, and off-site impact, to the entire squirrel population including future generations. Conversely, planting forested corridors that connect two forest patches would be beneficial to these squirrels. Some planners in the tropics have even provided aerial bridges over roadways to allow for safe road crossings for arboreal species (e.g., monkeys, tree squirrels).

This example illustrates how many species can be indirectly impacted by habitat changes. Each species has unique requirements and capabilities for habitat connectivity and movement capacity (e.g., salamanders have trouble crossing roads, birds do not), habitat patch size requirements (e.g., Wood Thrush needs a larger patch of woods than Gray Treefrog), and particular critical habitat components (e.g., treefrogs must have a breeding pond, snakes a winter denning site, many insects require a particular species of nectar or larval food plant). These particular requirements and impacts should be evaluated for each SLCI expected to be impacted to find a least harm alternative, and to select remediation choices that benefit the most species.

2.3 Mammals

Several mammal SLCI have been confirmed, including Coyote and Southern Flying Squirrel. The Southern Flying Squirrel requires mature forest with mast bearing trees, and will be impacted by any reduction in mature forest canopy or mast bearing trees. New roadways would also increase mortality for both species. Light pollution remediation is a concern for the nocturnal squirrels, as well as for bats.

The Milwaukee Estuary AOC study has collected bat data and found bat activity levels to be quite high during the maternity season, especially around the ponds and along forest edges. Some bat species require tree cavities and loose bark retreats under closed canopy foliage for raising young, conditions typical of mature hardwood forest such as Sanctuary Woods. Acoustic bat data collected are currently being analyzed for species identifications at the University of Illinois, which should yield a preliminary species list later this year. Most bat species in Wisconsin are Threatened or Special Concern, and one is federally listed as well (Northern Long-eared Bat, which should be present at Milwaukee County Grounds only in migration). At this time we can say that bat activity is high in this area making bat conservation a high priority, and that Sanctuary Woods and wetlands are critical habitats. The area is similarly important as migration habitat for bats in spring and fall. Bats also provide considerable social value in the enormous number of insects they consume.

2.4 Breeding Birds

The Milwaukee County Grounds contains approximately 50 acres of grassland habitat, intermixed with pockets of shrubland and transitional plant communities adjacent to the woodlands located within the southeastern section. Grassland ecosystems are extremely rare and often degraded within urban areas such as Milwaukee County because they are frequently developed and/or fragmented. According to the United States Fish and Wildlife Service, results from the national Breeding Bird Survey indicate that grassland bird populations are declining at a faster rate than any other group of North American birds. Recent survey data collected by the DPRC and UWMFS, as well as by other local experts, confirm the presence of several grassland bird species utilizing the grassland habitat during their breeding season including Boblink, Dickcissel, Field Sparrow, Eastern Meadowlark, and Vesper Sparrow. Each of these species are SLCI and are listed as Species of Greatest Conservation Need in the Wisconsin Wildlife Action Plan (WDNR). Additionally, historical records harvested from eBird and miscellaneous observations by UWMFS surveyors also indicate that other grassland dependent bird species may have recently attempted to breed on site, including the State Threatened Henslow's Sparrow, Grasshopper Sparrow, and Special Concern Dickcissel. Marsh associated SLCI are also present (Sora Rail, Virginia Rail).

In order to conserve the unique breeding bird populations and critical grassland habitat within the site, any form of fragmentation, or infrastructural projects leading to increased mortality (vehicle collisions, increased predator activity along roads) should be carefully assessed and avoided if possible. Most species have minimum area requirements, below which breeding success is compromised. Light and noise pollution remediation should also be addressed, as well as habitat quality management. While specific proposals are beyond the scope of this memorandum, control of invasive species, and establishment of more native and diverse plant communities, would enhance breeding bird habitat with increased food, shelter, and protection from predators. For ground nesting birds, strict enforcement of dog leash laws would also prove beneficial. Breeding birds are very popular with the public and therefore have significant social and human health value as well. A full list of grassland associated species (not restricted to SLCI) can be gleaned from the Species Checklists for benefit analyses of any proposed habitat projects.

2.5 Amphibians & Reptiles

The Milwaukee County Grounds currently supports four snake species qualifying as SLCI: Butler's Gartersnake, Common Gartersnake, Eastern Milksnake, and DeKay's Brownsnake. The Butler's Gartersnake is also a state listed Special Concern species in Wisconsin and a Species of Greatest Conservation Need in the State Wildlife Action Plan. Butler's Gartersnake has been the focus of a long-term population recovery effort conducted by Dr. Gary S. Casper (UWMFS) and the Milwaukee Metropolitan Sewage District. Significant public funding and resources have gone into salvaging snakes prior to construction of the retention basins, and habitat management and monitoring of snakes to ensure recovery, since 2007. The area proposed for a new roadway has been verified to contain habitat features that are critical to this and other snake species survival within the site, including breeding habitat and snake denning areas. While snake dens can be recreated elsewhere, this is expensive, success is not

guaranteed, and in this case dens are multi-generational with adults marking pathways to the dens with pheromones so that naive young snakes can find these traditional den sites. Mating also occurs when snakes are congregated at the dens, and has been witnessed by Dr. Casper and his assistants on several occasions at the site proposed for a new road. Relocating adults typically results in high mortality as they inevitably attempt to find their familiar traditional areas. Therefore, preference should be given to preserving existing denning areas, as the resources required to create new snake denning areas and monitor their effectiveness can often exceed the benefits, particularly when suitable denning areas are already present. Maintaining habitat connectivity between the dens and the grassland and detention basin wetland habitats is also critical. Currently, the proposed roadway locations would directly destroy dens, and would constitute new barriers to movement, both of which would likely to result in severe mortality and a population crash.

Historical and recent survey data collected by the DPRC and UWMFS also confirm the presence of Northern Leopard Frog, Green Frog, and Gray Treefrog within the project area, all currently ranked as SLCI. These same studies confirm that all salamander species, also SLCI, are now extirpated from this area, but potential exists to repatriate them. Historical records demonstrate that they were formerly present. Partners in Amphibian and Reptile Conservation (PARC) describe roads as having the potential to substantially impact the viability of many amphibian and reptile populations due to increased mortality and habitat fragmentation, and the Milwaukee Estuary AOC study identifies habitat fragmentation and road mortality as major impairments throughout the AOC and at County Grounds. PARC recommends that road placement should take into account the locations of sensitive habitats, such as ephemeral wetlands and denning areas, and avoid them. Minimizing habitat loss and avoiding new roads into existing habitat areas is expected to be a key element recommended for achieving delisting of BUIs in the AOC, including at the County Grounds. In particular, destruction of existing critical habitat components supporting SLCI, such as snake dens, would be viewed as counter-productive without effective remediation achieved, and in this case, as devaluing public investment expended since 2007 to recover this particular snake population.

A number of habitat and population enhancements for amphibians and reptiles could be considered at the County Grounds and Sanctuary Woods. While detailed proposals are beyond the scope of this memo, chief among these actions would be the creation of more suitable breeding ponds, protected from roadway runoff (including salt). If achieved, such ponds could enable the repatriation of salamanders in this area, as well as additional frog species. This would have a cascading ecological effect, providing for more dragonfly, snake, mammal, and bird habitat as well. A full list of wetland associated species (not restricted to SLCI) can be gleaned from the Species Checklists for benefit analyses of any proposed habitat projects. Moreover, ponds are highly suitable to enabling public nature observation and immersion, thereby providing social and recreational benefits as well.

2.6 Dragonflies & Damselflies

Surveys by the UWMFS have identified 20 species to date at the Milwaukee County Grounds: Autumn Meadowhawk, Band-Winged Meadowhawk, Black Saddlebags, Blue Dasher, Calico Pennant, Common Baskettail, Common Green Darner, Dot-Tailed Whiteface, Eastern Forktail, Eastern Pondhawk, Familiar Bluet, Marsh Bluet, Northern Spreadwing, Ruby Meadowhawk, Sweetflag Spreadwing, Tule Bluet, Twelve-Spotted Skimmer, Wandering Glider, White-Faced Meadowhawk, and Widow Skimmer. These species forage over wetlands, grasslands and forest edges, and are important components of the ecosystem both as foragers on other insects, and as important seasonal prey for amphibians, birds, and bats. Too little is known about this group to designate species' conservation status, but they are subject to road mortality which would increase with road density. Conservation planning should focus on quality habitats, especially for the aquatic larvae which are sensitive to chemical contaminants.

2.7 Primary Burrowing Crayfish

No primary burrowing crayfish are yet known to be established at Milwaukee County Grounds, but the area is suitable for repatriation of Prairie Crayfish. This SLCI is a keystone species, which builds deep burrows that provide critical habitat for dragonflies, amphibians, and reptiles. These burrows serve as drought refuges and winter dens. Repatriation of Prairie Crayfish is a fairly obvious conservation objective at Milwaukee County Grounds, including at the forested wetland within Sanctuary Woods. The most important limiting factor may be runoff contaminants entering these wetlands.

2.8 Light Pollution

Light pollution has a variety of effects on wildlife and human health. Many nocturnal animals can have their activities compromised and stress levels raised by excessive night lighting, particularly lighting in the blue spectrum. Recent research on humans has resulted in a "night shift" setting available on some smart phones, which reduces the harmful effects of screen light by changing the light spectrum and intensity after sunset. Similar research on street and security lighting is available, with best practice remedies available such as shielding light emissions (to direct light only where it is needed), changing emission spectrums, effective placement, and utilizing motion sensors to avoid constant emission. Many of these innovations save energy costs as well. An analysis of lighting effects, and recommended solutions, is well beyond the scope of this memo, but it is strongly recommended that this subject be given thorough consideration, especially given the presence of nocturnal SLCI in the project area.

The American Medical Association has adopted guidance to reduce harm from high intensity street lights (<https://www.ama-assn.org/ama-adopts-guidance-reduce-harm-high-intensity-street-lights>). The Urban Wildlands Group has made available a bibliography of night lighting literature (<http://www.urbanwildlands.org/nightlightbiblio.html>). Additional information is available from the International Dark-Sky Association (<http://darksky.org/>). The following references also provide some background on this issue: Arble et al. 2010, Baker & Richardson 2006, Blackwell et al. 2015, Cloyd & Eason 2015, Delhey & Peters 2017; Gaston et al. 2013, 2014; Hale et al. 2015, Hölker et al. 2010, Kyba et al. 2011, Longcore 2006, Schoeman 2016, Spoelstra et al. 2015, and Wright et al. 2013.

2.9 Noise Pollution

An analysis of noise pollution effects, and recommended solutions, is well beyond the scope of this memo, but it is strongly recommended that this subject be given thorough consideration in planning, especially given the presence of many SLCI in the project area that communicate acoustically. Excessive noise is well documented to have detrimental effects on humans, making remediation of, and planning for, reduced noise an often neglected public health issue. Noise and human health has been addressed by the World Health Organization (<http://www.euro.who.int/en/health-topics/environment-and-health/noise>), and the following references address some effects on animals: Bee & Swanson 2007, Cardoso 2014, Cunnington 2015, Francis et al. 2011, Hanna et al. 2014, McClure et al. 2016, Troianowski et al. 2017, and Vargas-Salinas et al. 2014.

2.10 Stopover Habitat

In addition to serving as crucial breeding habitat for declining bird species, the entire Milwaukee County Grounds area and connected river corridors provide essential stopover habitat for migratory birds, mammals (bats), and invertebrates (e.g., Monarch Butterfly, dragonflies and damselflies). To date, 142 species of birds have been documented utilizing the Milwaukee County Grounds for either breeding or migratory stopover habitat (eBird), 48 of which are identified as priority species for conservation in Wisconsin's "All Bird Conservation Plan". Some key planning components to consider for stopover habitat are: refueling by providing sufficient food resources, shelter from predators for exhausted migrants, habitat extent and connectivity (size is important, fragmentation reduces this beneficial use), and light pollution (affects predation, stress, and discovery of habitats from the air).

For more information on this subject:

<http://wglbbo.org/what-we-do/midwest-landbird-migration-monitoring-network>

<http://greatlakes.audubon.org/landing/migratory-stopover-habitat>

<http://glmigratorybirds.org/>

2.11 Roosting Habitat

The Milwaukee County Grounds provides one of only three known winter roosting habitat areas for Long-eared Owls in the Milwaukee Estuary AOC. These owls are a Special Concern species and SLCI. They require safe daytime roosts, typically in dense brushy woods, adjacent to adequate winter foraging areas (large grasslands). Few such areas remain in urban settings. Any conservation planning should address maintaining this critical habitat feature. The owls are also popular with the public and have social value.

2.12 Pollinators and Butterflies

Milwaukee County Grounds is well known as an important Monarch Butterfly habitat. Other butterflies and moths are supported as well. Habitat for butterflies and other pollinators, such as bees, depends upon the availability of quality native forage plants, both during migration and throughout the active season. There is some evidence that the Federally Endangered Rusty-patched Bumblebee occurs in the area (it was documented nearby in 2012), and Milwaukee County Grounds could easily provide habitat for this rare species. Habitat goals for these groups overlaps with habitat goals for grassland birds to a large degree. Planning should address preserving and enhancing this resource through maintenance of wildflowers that provide nectar and pollen. These habitat features provide social and recreational benefits as well.

For further information:

<http://www.xerces.org/pollinators-great-lakes-region/>

<http://greatpollinatorproject.org/management/stopover-habitat>

<https://www.fws.gov/pollinators/>

<https://www.fs.fed.us/wildflowers/pollinators/index.shtml>

http://www.dnr.state.mn.us/pollinator_resources/index.html

2.13 Habitat Connectivity

Overall habitat connectivity is also a very important feature to maintaining populations of most wildlife, and for providing adequate habitat resources. Any proposed new roadways or development should avoid further isolating habitats patches. Features such as ecopassages can be considered to reconnect currently isolated habitats, and be incorporated into new design as well.

2.14 Notes on Some Other Critical Habitat Features

Ephemeral Wetlands

There is several ephemeral wetlands present in the Milwaukee County Grounds, and one in Sanctuary Woods. Ephemeral wetlands are critical breeding habitat for native amphibians and invertebrates, important foraging habitat for many birds, and are not delineated on WDNR wetland maps. Ephemeral wetlands have been defined by the WDNR as “depressions with impeded drainage (usually in forest landscapes), that hold water for a period of time following snowmelt and spring rains but typically dry out by mid-summer. They flourish with productivity during their brief existence and provide critical breeding habitat for certain invertebrates, as well as for many amphibians such as frogs and salamanders. They also provide feeding, resting and breeding habitat for songbirds and a source of food for many mammals.” These wetlands can easily be degraded by surface water runoff from roads and the destruction of critical upland habitat surrounding them. Roads and trails should be located away from ephemeral wetlands and

transitional zones into upland habitats. Ephemeral wetlands provide critical habitat for several SLCI and state listed species at Milwaukee County Grounds, and should be preserved and enhanced.

Area Containing State-threatened Species (Forked Aster)

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) conducted vegetation surveys in the area from 1975 through 1998. These surveys confirmed the presence of Forked Aster (*Eurybia furcata*), resulting in the designation of an Isolated Natural Resource Area. Additional vegetative surveys conducted by the DPRC reconfirmed the presence of Forked Aster within the site in 2012. The Forked Aster is a State Threatened species, therefore negative impacts to its populations within the site should be avoided and are regulated. To avoid impact, a well designed Master Plan should designate specific habitat preservation and management areas, and habitat buffers, to ensure survival of this rare species.

3. Conclusions

As planning moves forward, the major themes outlined here are appropriate elements for inclusion in a Master Plan that will address both *social* and *biological constraints* to develop a balanced plan that serves the community as a whole. The most fundamental message is that both *social* and *biological constraints* must be defined, with planning recognizing that the *biological constraints* are not negotiable, while the *social constraints* are. In the end, it comes down to addressing the specific critical habitat requirements of the species intended to be supported, then reframing *social constraints* to achieve that objective. This process usually begins by initially selecting a suite of desired Focal Species that represent the habitat features considered to be feasible within the expected social constraints, then planning proceeds around the *biological constraints* to support the full life cycle requirements of the selected Focal Species. If conflicts arise, either biological expectations must be reduced, or *social constraints* eased.

For example, the community may decide that preserving a viable Flying Squirrel population is a goal, and use the squirrels as a Focal Species to represent a vibrant and sustainable mature forest community, that includes wellness trails. The *biological constraints* then include maintaining mature trees with cavities, nut bearing trees and shrubs, a minimum forest extent without fragmentation, forested corridors connecting forest patches, control of invasive species, subdued nighttime lighting (avoiding the blue light spectrum), and nest boxes as a habitat feature. The planning team then realizes that it takes little more effort to introduce a wetland feature, so that other forest dependent species can also be supported, perhaps Wood Frog and Blue-spotted Salamander, or Wood Thrush and a variety of tree roosting bats. Minor adjustments add additional features to the plan to support these new species, including attention to maintaining a good duff layer by controlling browsing and establishing wildflowers. At some point funding (a *social constraint*) for maintaining a proposed deer enclosure cannot be achieved, so the proposed establishment of a trillium population (a regionally rare wildflower) is abandoned.

A similar scenario could unfold for grassland habitats. The point here with this example is that the process of planning for wildlife habitat that supports viable populations is feasible, with a little help from conservation biologists, and would enable a plan that truly integrates the natural environment with desired social benefits.

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Academic Affairs

Provost and Vice Chancellor

Date: December 12, 2016

To: Supervisor John F. Weishan Jr., Sponsor
Members of the Milwaukee County Board of Supervisors
Barb Agnew, Founder and President, Friends of the Monarch Trail; and
All interested Parties to County Board Resolution No. 16-532

From: Johannes J. Britz, Provost & Vice Chancellor, Division of Academic Affairs, University of Wisconsin-Milwaukee

Re: Letter of authorization for UWM faculty involvement and input on an environmental impact assessment of potential development in a designated environmental corridor on the Milwaukee County Grounds.

Dear Supervisor Weishan, et al.,

It is my pleasure as Provost & Vice Chancellor of the University of Wisconsin-Milwaukee and Southeast Wisconsin's premier research institution to authorize UWM faculty members Dr. Neil O'Reilly, representing the Department of Conservation and Environmental Sciences, and Dr. Gary Casper, representing the UWM Field Station, to participate as lead investigators in preparing an environmental impact assessment report to the Milwaukee County Board of Supervisors, as requested in Board Resolution 16-532.

Whenever economic development, even where considered highly desirable, poses a potential impact to fragile ecosystems, it is important to assess and determine what those impacts may be and to propose a correct balance between differing interests. Knowledge alone can guide us in these pursuits.

Pursuant to this university's core mission and the "Wisconsin Idea," it is appropriate and relevant for our expert faculty to be involved in such studies and to lend credence to their ultimate findings, especially when called upon by our own community. Drs. O'Reilly and Casper are eminently qualified to serve in this capacity.

Sincerely,

A handwritten signature in black ink, appearing to read "J. Britz", with a date "12/12" written below it.

Johannes J. Britz
Provost & Vice Chancellor
University of Wisconsin-Milwaukee

Date: March 1, 2017

Sent Via E-Mail

To: Environmental Impact Assessment Committee for the Northeast Quadrant of the County Grounds

From: Neal O'Reilly, Ph.D., PH

Subject: Potential Urban Footprint and Stormwater Runoff Impacts from the Proposed Development of "Sanctuary Woods" as Part of the Wauwatosa Life Sciences District

Introduction

The following memo was prepared to assess the potential physical footprint and stormwater runoff impacts of the Proposed Development of "**Sanctuary Woods**" as Part of the Wauwatosa Life Sciences District. Information for this assessment was taken from the document titled "**Wauwatosa Life Sciences District: 2016 Master Plan**" (January 12, 2017 DRAFT). The footprint for the proposed development was taken from the figure located on page 90 of the document (Figure 1).



Figure 1

Proposed development in the Sanctuary Woods area of the Milwaukee County Grounds.

(Source: Wauwatosa Life Sciences District: 2016 Master Plan (January 12, 2017 DRAFT))

For this analysis the "Sanctuary Woods" is defined as Tax Key number 373-9999-07 (northwest of the power plant) and the western half of Tax Key 372-9999-17 as shown in Figure 2.



Figure 2 - Location of “Sanctuary Woods” Used in this Analysis

For the analysis Figure 1 was georeferenced into ArcGIS and the center lines of the proposed roads and outlines of the buildings were digitized as shown on Figure 3. Areas for the proposed roads and buildings were calculated, and summarized in Table 1. The *Wauwatosa Life Sciences District: 2016 Master Plan* does not specify the exact number of floors in each building or whether or not the proposed development will have underground parking or surface parking. Therefore, this analysis included two potential scenarios;

- Scenario 1 assumes that all of the building will all have underground parking, and
- Scenario 2 assumes that all of the lots will have surface parking equal to the size of the building.

Footprint of Proposed Development

Table 1 summarizes the footprint of the current development and the two assume development scenarios.

Table 1
Footprint of Proposed Development in “Sanctuary Woods”

Land Use	Current (ac)	Scenario 1 (ac)	Scenario 2 (ac)
Forest	33.8	15.9	7.0
Roads	1.4	10.9	10.9
Building	0.3	8.9	8.9
Parking	0.2	0	8.9
Total	35.7	35.7	35.7

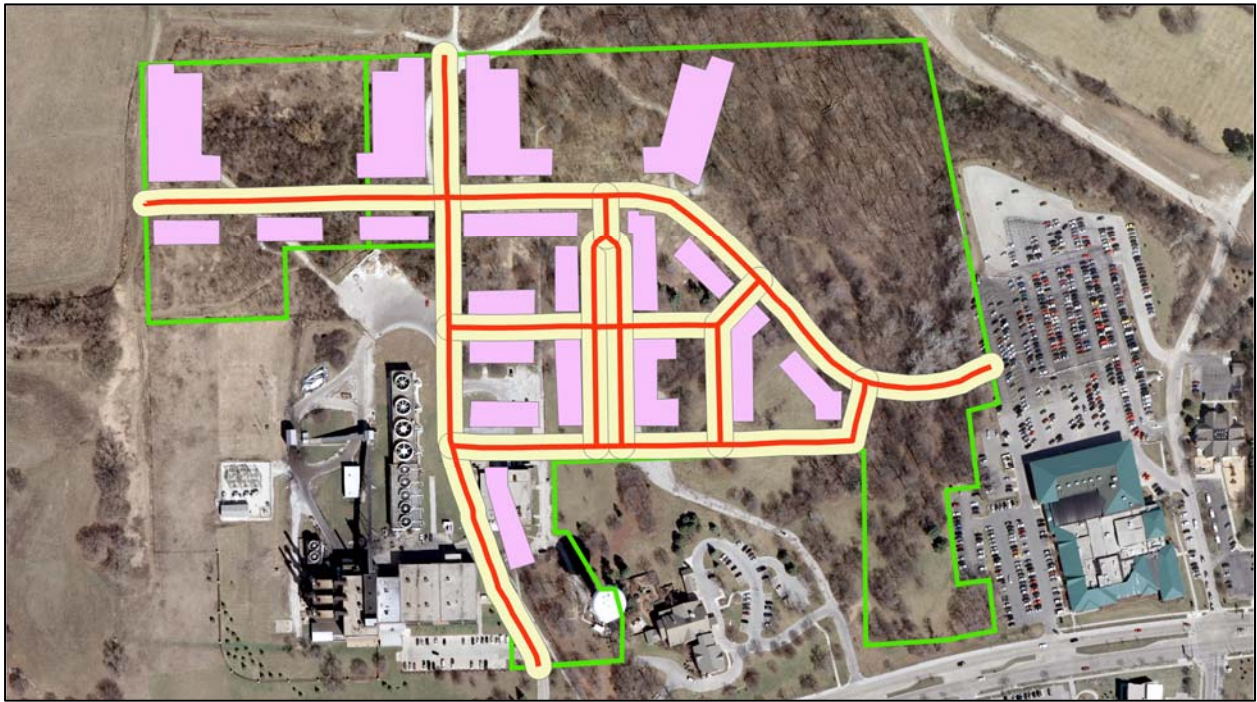


Figure 3 - Locations of Proposed Roads and Buildings in “Sanctuary Woods” Taken from Figure 1

Stormwater Runoff

To calculate the change in volume of surface water runoff, the Long Term Hydrologic Impact Analysis (L-THIA) model developed by Purdue University was used. L-THIA estimates long-term average annual runoff from land use and soil combinations, based on actual long-term climate data for the area. The runoff volume component of the model utilizes the NRCS Runoff Curve Method (TR-55). For this analysis an average annual rainfall depth of 42.55 inches was used.

Table 2 outlines the results assuming no onsite infiltration. **The Wauwatosa Life Sciences District: 2016 Master Plan** does not specify how the stormwater will be managed. It is assuming that the project will comply with the MMSD stormwater requirements of a maximum discharge of 0.15 cubic feet per second per acre for the 50%/2-year storm and 0.5 cubic feet per second per acre for the 1%/100-year storm and not result in a major increase in peak discharge. However, even though detention can reduce peak rates of stormwater discharge, it will not reduce the volume of runoff, the same volume will be discharged only over a longer period of time and could result in 70% to 104% increase in runoff volume over current conditions.

Table 2 - Average Annual Runoff Volume (acre-ft)

Land Use	Current	Scenario 1	Scenario 2
Forest	26.14	12.29	5.49
Roads	2.71	21.13	21.13
Building/Parking	0.96	17.25	34.31
Total Annual Volume (acre-ft)	29.83	50.68	60.94
Percent Increase from Existing conditions %	-	69.9% increase	104.3% increase

Water Pollutants

To estimate the potential export of stormwater pollutants from the proposed Sanctuary Woods Development, the Long Term Hydrologic Impact Analysis (L-THIA) model developed by Purdue University was also used. The results of the L-THIA pollutant modeling are summarized in Table 3. The modeling does not represent the results that may exist if stormwater management practices are put in place.

The Wisconsin stormwater regulations outlined in Wisconsin Administrative Code NR 151 require *“For new development, by design, reduce to the maximum extent practicable, the total suspended solids load by 80%, based on an average annual rainfall, as compared to no runoff management controls. No person shall be required to exceed an 80% total suspended solids reduction to meet the requirements of this subdivision. “*

Proposed annual total suspended solids exports are estimated to be 5,837 pounds under Scenario 1 and 8,427 pounds under Scenario 2. With an 80% reduction through stormwater management the export would be reduced to 1,167 pounds per year and 1,685 pounds per year respectively. This would result in a 1,456% increase and 2,140% increase in total suspended solids based on Scenarios 1 and 2 respectively compared to current conditions. Other particulate pollutants such as total phosphorus, and heavy metals are expected to have similar increases in export.

Table 3 – Estimated Pollutant Exports under Current Conditions and Scenarios 1 and 2 With No Management

Nitrogen (lbs)				Chromium (lbs)			
Land Use	Current	Scenario 1	Scenario 2	Land Use	Current	Scenario 1	Scenario 2
Forest	49.0	23.0	10.0	Forest	0.5	0.3	0.1
Road	9.0	77.0	77.0	Road	0.1	0.6	0.6
Building	2.0	63.0	63.0	Building	0.0	0.5	0.5
Parking	1.0	0.0	63.0	Parking	0.0	0.0	0.5
Total	61.0	163.0	213.0	Total	0.6	1.3	1.6

Phosphorous (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.7	0.3	0.1
Road	2.0	18.0	18.0
Building	0.5	15.0	15.0
Parking	0.3	0.0	15.0
Total	3.6	33.3	48.1
Suspended Solids (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	71.0	33.0	14.0
Road	410.0	3,195.0	3,195.0
Building	87.0	2,609.0	2,609.0
Parking	58.0	0.0	2,609.0
Total	626.0	5,837.0	8,427.0
Lead (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.4	0.2	0.1
Road	0.1	0.7	0.7
Building	0.0	0.6	0.6
Parking	0.0	0.0	0.6
Total	0.5	1.5	2.0
Copper (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.7	0.3	0.1
Road	0.1	0.8	0.8
Building	0.0	0.7	0.7
Parking	0.0	0.0	0.7
Total	0.9	1.9	2.3
Zinc (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.4	0.2	0.1
Road	1.0	10.0	10.0
Building	0.3	8.0	8.0
Parking	0.2	0.0	8.0
Total	1.9	18.2	26.1

Nickel (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.0	0.0	0.0
Road	0.1	0.7	0.7
Building	0.0	0.6	0.6
Parking	0.0	0.0	0.6
Total	0.1	1.2	1.8
BOD (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	35.0	16.0	7.0
Road	170.0	1,324.0	1,324.0
Building	36.0	1,081.0	1,081.0
Parking	24.0	0.0	1,081.0
Total	265.0	2,421.0	3,493.0
COD (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.0	0.0	0.0
Road	857.0	6,679.0	6,679.0
Building	183.0	5,453.0	5,453.0
Parking	122.0	0.0	5,453.0
Total	1,162.0	12,132.0	17,585.0
Oil & Grease (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.0	0.0	0.0
Road	66.0	518.0	518.0
Building	14.0	423.0	423.0
Parking	9.0	0.0	423.0
Total	89.0	941.0	1,364.0
Fecal Coliform (millions of coliform)			
Land Use	Current	Scenario 1	Scenario 2
Forest	64.0	30.0	13.0
Road	231.0	1,805.0	1,805.0
Building	49.0	1,474.0	1,474.0
Parking	33.0	0.0	1,474.0
Total	377.0	3,309.0	4,766.0

Cadmium (lbs)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.1	0.0	0.0
Road	0.0	0.1	0.1
Building	0.0	0.0	0.0
Parking	0.0	0.0	0.0
Total	0.1	0.1	0.2

Fecal Strep (millions of coliform)			
Land Use	Current	Scenario 1	Scenario 2
Forest	0.0	0.0	0.0
Road	605.0	4,711.0	4,711.0
Building	129.0	3,846.0	3,846.0
Parking	86.0	0.0	3,846.0
Total	820.0	8,557.0	12,403.0

Conclusion

The proposed development of “**Sanctuary Woods**” as part of the **Wauwatosa Life Sciences District** could result in an increase in stormwater runoff volume by as much as 70 to 104 percent, depending on the level of building sizes and amount of surface parking (Scenarios 1 versus 2). Total suspended solids levels with stormwater management could increase between 1,456 and 2,140 percent even with stormwater treatment practices in compliance with Wisconsin Administrative Code NR 151, based on Scenarios 1 and 2 respectively. Even with stormwater management practices that comply with local and state regulations the development of “**Sanctuary Woods**” as part of the **Wauwatosa Life Sciences District** will result in significant increase in stormwater volumes and pollutant export.

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Excerpts from articles and news reports: Dr. Marc Gorelick-Former COO
of Children's Hospital on preserving the Asylum Grounds
Including comments from members of the medical community*

Gorelick wants to see it preserved and fixed up for the community and hospital patients. Ronald McDonald house president Ann Petrie also supports the idea.

"It gives you a complete feeling of tranquility and peace and to be able to walk through the existing path and really get that sense of nature is a fantastic feeling," Petrie said.

And that's really all Gorelick wants to see happen, children playing, and families enjoying, a natural dose of medicine to get out of the hospital's four walls. He says he's working closely with the parks director to see it happen.

<http://www.cbs58.com/story/29152398/childrens-hospital-coo-eyes-nearby-woods-for-healing-power>

Dr. Marc Gorelick didn't set out to make an environmental statement. He simply wants to set aside a few acres of green space for sick kids to find peace and quiet.

Those acres just happen to be part of a contested piece of the Milwaukee County Grounds.

The closest neighbor to the natural area is the Ronald McDonald House, and Gorelick says its leaders are keen about the idea.

He also knows of other hospitals around the country that have created scapes to feel natural.

"And we have that right here. We've got the large trees and we heard the ducks and the birds and here we are just a few hundred feet from Watertown Plank Road but you feel like you're away from it all," Gorelick says.

"James, who has spina bifida, has spent a lot of time at Children's Hospital of Wisconsin. But he's pretty unimpressed with our clinics and operating rooms. What gets him going is the park-like space across the street on the County Grounds."

Gorelick received a speedy reaction. "Probably three or four people from the hospital contacted me afterwards and said 'that would be so cool! I want to help make that happen' I said okay you're on," he says.

What he does know is that he'd like to leave the wooded lot as untouched as possible.

"I think we want to keep it very simple. Have it maintained and marked. Probably have some benches so that people can sit and rest, because they'll need that; and at least some portion that is accessible for everybody," he says.

Gorelick says the young patient's words continue inspiring him.

"James was very articulate about how important it was for him in a nice place for him to feel better. He said this is one of his favorite spots," Gorelick says.

<http://wuum.com/post/doctors-quiet-mission-preserve-parcel-milwaukee-county-grounds#stream/0>

There is a growing awareness of the power of nature to heal. [Children in particular](#) seem to have a need for some "wildness" for their well-being. Many hospitals have installed gardens: we have our own lovely [Noel Family Healing Garden](#), for which many of our families are tremendously grateful. Other hospitals have gone further, investing in more extensive adjacent nature trails. Mid Coast Hospital in Maine, for example, describes its [3300 feet of paths](#) as a place of exercise and contemplation for patients and visitors (and staff).

I'm imagining a Wellness Trail, meandering through the woods and wetlands just a few hundred feet from the hospitals, and now easily reached by a pedestrian bridge. A place where kids like James and Finley could wander, soaking up the healing energy of the natural world to complement the various therapies we provide. And maybe seeing a hawk, or a deer, or a caterpillar.

* <https://startingwithcurious.com/2014/06/06/hitting-the-wellness-trail/>



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To: Parks, Energy and Environment; Jason Haas, Chair,
jason.haas@milwaukeecountywi.gov
RE: Resolution regarding County Grounds before the Milwaukee County Board
Committee on Parks, Recreation and Culture
From: Gary S. Casper, Ph.D., Principle Investigator, Milwaukee Estuary AOC study,
gscasper@uwm.edu
Date: October 19, 2016
cc: Supervisor Schmitt, James.Schmitt@milwaukeecountywi.gov
Supervisor Weishan, Jr., john.weishan@milwaukeecountywi.gov;
Supervisor Dimitrijevic, marina.dimitrijevic@milwaukeecountywi.go
Supervisor Lipscomb, theodore.lipscomb@milwaukeecountywi.gov
Committee Members:
Marcelia Nicholson, Vice Chair, marcelia.nicholson@milwaukeecountywi.gov
Steve F. Taylor, steve.taylor@milwaukeecountywi.gov
Dan Sebring, dan.sebring@milwaukeecountywi.gov
Sheldon A. Wasserman, sheldon.wasserman@milwaukeecountywi.gov
Dr. James A. Reinartz, Director, UWM Field Station, jimr@uwm.edu

To Whom It May Concern:

The Resolution proposed by Supervisor Weishan, Jr., has been shared with me (attached). While I have never met or spoken with Supervisor Weishan, Jr., I can attest that I have been leading wildlife studies at County Grounds since 2007. Our current project began in 2014 in cooperation with the Milwaukee County Department of Parks, Recreation & Culture, and the Wisconsin DNR Office of the Great Lakes, as described below. Through this work we have identified many sensitive species and critical habitats that meet the criteria for consideration as Beneficial Use Impairments under the U.S. Environmental Protection Agency Area of Concern program. We are currently identifying recommendations to delist these impairments by recovering species and habitats in the area. We have discovered wildlife species and habitats at County Grounds that were overlooked in previous assessments. We are willing to share and discuss these data and insights with any assessments that result from this Resolution. Please note the data collected in our ongoing UWM Field Station studies are not available through other UWM Departments, and have not yet been considered in SEWRPC natural area assessments. We therefore are confident we can add substantial value to any discussions.

Background

The Milwaukee County Grounds contains several verified populations of sensitive wildlife species as well as critical species habitat features. The critical species habitat to

be impacted by the proposed construction (Figure 1) falls within the federally designated Milwaukee Estuary Area of Concern (AOC). Beneficial Use Impairments (BUI) of loss and degradation of fish and wildlife habitat and populations have been identified in the Milwaukee Estuary AOC. In order to address the federal delisting of this BUI, the Milwaukee County Department of Parks, Recreation & Culture (DPRC) and University of Wisconsin-Milwaukee Field Station (UWMFS) have collected baseline data on historical and existing wildlife populations and habitat conditions throughout the AOC, and, in cooperation with the Fish and Wildlife Technical Team for the AOC (administered by the Wisconsin DNR Great Lakes Office), identified Species of Local Conservation Interest (SLCI) that are considered to be impaired and are eligible for recovery actions. On the Milwaukee County Grounds critical species habitats have been confirmed within the site, including snake denning areas, grassland nesting bird habitat, forested roosting and foraging habitat, and an ephemeral wetland. Additionally, state-listed species and Species of Local Conservation Interest have been confirmed on the site and are described below. Preservation of these key resources should be of high priority. Impacts to these species and their associated habitats can be evaluated following a "*first do no harm*" principle, which first avoids impacts through plan modifications, and then mitigates any necessary impacts based on critical habitat needs of the affected species.

Amphibians & Reptiles

The Milwaukee County Grounds currently supports four snakes meeting the AOC criteria of Species of Local Conservation Interest (SLCI): Eastern Milksnake, DeKay's Brownsnake, Common Gartersnake, and Butler's Gartersnake. The Butler's Gartersnake is also a state listed Special Concern (SC) species in Wisconsin and a Species of Greatest Conservation Need in the State Wildlife Action Plan. The Butler's Gartersnakes have been the focus of a long-term population recovery effort conducted by Dr. Gary S. Casper (UWMFS) and the Milwaukee Metropolitan Sewage District. Significant public funding and resources have gone into salvaging snakes prior to construction of the retention basins, and habitat management and monitoring of snakes to ensure recovery, since 2007. The area proposed for a new roadway has been verified by Casper to contain habitat features that are critical to this species survival within the site, including breeding habitat and snake denning areas. While snake dens can be recreated elsewhere, this is expensive, success is not guaranteed, and in this case dens are multi-generational with adults marking pathways to the dens with pheromones so that naive young snakes can find these traditional den sites. Mating also occurs when snakes are congregated at the dens, and has been witnessed by Dr. Casper and his assistants on several occasions at the site proposed for a new road. Relocating adults typically results in high mortality as they inevitably attempt to find their familiar traditional areas. Therefore, preference should be given to preserving existing denning areas. The resources required to create new snake denning areas and monitor their effectiveness can often exceed the benefits, particularly when suitable denning areas are already present.

Historical and recent survey data collected by the DPRC and UWMFS also confirm the presence of several frogs ranked as SLCI within the site: Northern Green Frog, Northern Leopard Frog, and Gray Treefrog. Partners in Amphibian and Reptile

Conservation (PARC) describe roads as having the potential to substantially impact the viability of many amphibian and reptile populations due to increased mortality and habitat fragmentation, and the AOC study identifies habitat fragmentation and road mortality as major impairments throughout the AOC and at County Grounds. PARC recommends that road placement should take into account the locations of sensitive habitats, such as ephemeral wetlands and denning areas, and avoid them. Minimizing habitat loss and avoiding new roads into existing habitat areas is expected to be a key element recommended for achieving delisting of BUIs in the AOC, including at the County Grounds. In particular, destruction of existing critical habitat components supporting SLCI, such as snake dens, would be viewed as counter-productive without effective remediation achieved, and in this case, as devaluing public investment expended since 2007 to recover this particular snake population.

Birds

The Milwaukee County Grounds contains approximately 50 acres of grassland habitat, intermixed with pockets of shrubland and transitional plant communities adjacent to the woodlands located within the southeastern section. Grassland ecosystems are extremely rare and often degraded within urban areas such as Milwaukee County because they are frequently developed and/or fragmented. According to the United States Fish and Wildlife Service, results from the national Breeding Bird Survey indicate that grassland bird populations are declining at a faster rate than any other group of North American birds. Recent survey data collected by the DPRC and UWMFS, as well as by other local experts, confirm the presence of several grassland bird species utilizing the grassland habitat during their breeding season including Field Sparrow, Eastern Meadowlark, and Vesper Sparrow. Each of these species are SLCI and are listed as Species of Greatest Conservation Need in the Wisconsin Wildlife Action Plan (WDNR). Additionally, historical records harvested from eBird and miscellaneous observations by UWMFS surveyors also indicate that other grassland dependent bird species may be breeding at the site, including the State Threatened Henslow's Sparrow, Grasshopper Sparrow, and Dickcissel (listed as Special Concern by WDNR), as well as SLCI marsh birds (Sora Rail, Virginia Rail). In addition to serving as crucial breeding habitat for these declining bird species, the site also provides essential stopover habitat for migratory birds, mammals (bats), and invertebrates (e.g., Monarch Butterfly). To date, 142 species of birds have been documented utilizing the site for either breeding or migratory stopover habitat (eBird), 48 of which are identified as priority species for conservation in Wisconsin's "All Bird Conservation Plan". In order to conserve the unique breeding bird populations and critical grassland habitat within the site, any form of fragmentation, or infrastructural projects leading to increased mortality (vehicle collisions, increased predator activity along roads) should be carefully assessed and avoided if possible.

Mammals

Several mammal SLCI have been confirmed, including Coyote and Southern Flying Squirrel. The Southern Flying Squirrels require mature forest, and will be impacted by any reduction in mature forest canopy proposed. New roadways would also increase mortality for both species.

Dragonflies & Damselflies

Surveys by the UWMFS have identified 16 species to date at the Milwaukee County Grounds: Band-Winged Meadowhawk, Black Saddlebags, Blue Dasher, Calico Pennant, Common Baskettail, Common Green Darner, Dot-Tailed Whiteface, Eastern Forktail, Eastern Pondhawk, Marsh Bluet, Ruby Meadowhawk, Sweetflag Spreadwing, Twelve-Spotted Skimmer, Wandering Glider, White-Faced Meadowhawk, and Widow Skimmer. These species forage over wetlands, grasslands and forest edges, and are important components of the ecosystem both as foragers on other insects, and as important seasonal prey for amphibians, birds, and bats. Too little is known about this group to designate species' conservation status.

Notes on Some Critical Species Habitats

1. Ephemeral Wetland

There is an ephemeral wetland present within the site (Figure 2). Ephemeral wetlands are critical breeding habitat for native amphibians and invertebrates, important foraging habitat for many birds, and are not delineated on WDNR wetland maps. Ephemeral wetlands have been defined by the WDNR as “depressions with impeded drainage (usually in forest landscapes), that hold water for a period of time following snowmelt and spring rains but typically dry out by mid-summer. They flourish with productivity during their brief existence and provide critical breeding habitat for certain invertebrates, as well as for many amphibians such as frogs and salamanders. They also provide feeding, resting and breeding habitat for songbirds and a source of food for many mammals.” These wetlands can easily be degraded by surface water runoff from roads and the destruction of critical upland habitat surrounding them. PARC recommends locating roads and trails away from ephemeral wetlands and transitional zones into upland habitats. This particular ephemeral wetland provides critical habitat for several SLCI and state listed species at County Grounds.

2. Area Containing State-threatened Species (Forked Aster)

The Southeastern Wisconsin Regional Planning Commission (SEWRPC) conducted vegetation surveys in the area from 1975 through 1998. These surveys confirmed the presence of Forked Aster (*Eurybia furcata*), resulting in the designation of this Isolated Natural Resource Area by SEWRPC (Figure 2). Additional vegetative surveys conducted by the DPRC re-confirmed the presence of Forked Aster within the site in 2012. The Forked Aster is a State Threatened species therefore negative impacts to its populations within the site should be avoided and are regulated.

Resources

- 2014-2016 Milwaukee Estuary AOC Baseline Wildlife Assessment, Milwaukee County DPRC & UWMFS. Ongoing data collection and population assessments, recommendations for SLCI and BUI delisting actions.
- Butler's Gartersnake long-term population study, UWMFS & MMSD. Ongoing data collection on population recovery after impact by construction of the detention basins.
- Casper, Gary S. 2006. Butler's Gartersnake Conservation Plan: Milwaukee County Grounds Floodwater Management Facility and Underwood Creek Rehabilitation Project, Milwaukee, Wisconsin. May 8, 2006. Technical report to: HNTB Corporation, 11414 West Park Place, Suite 300, Milwaukee, WI 53224.
- Kingsbury, B. A., and J. Gibson. 2012. Habitat Management Guidelines for Amphibians and Reptiles of the Midwestern United States. Partners in Amphibian and Reptile Conservation Tech. Publ. HMG-1, 2nd ed. 155pp.
- SEWRPC. 2010. Amendment to the Natural Areas and Critical Species Habitat Protection and Management Plan for Southeastern Wisconsin. Southeastern Wisconsin Regional Planning Commission, W239 N1812 Rockwood Drive, P.O. Box 1607, Waukesha, WI 53187-1607. December 2010. 342pp. www.sewrpc.org.
- eBird: www.eBird.org, Cornell Lab of Ornithology. Online database archiving avian observations, reviewed by expert committee.

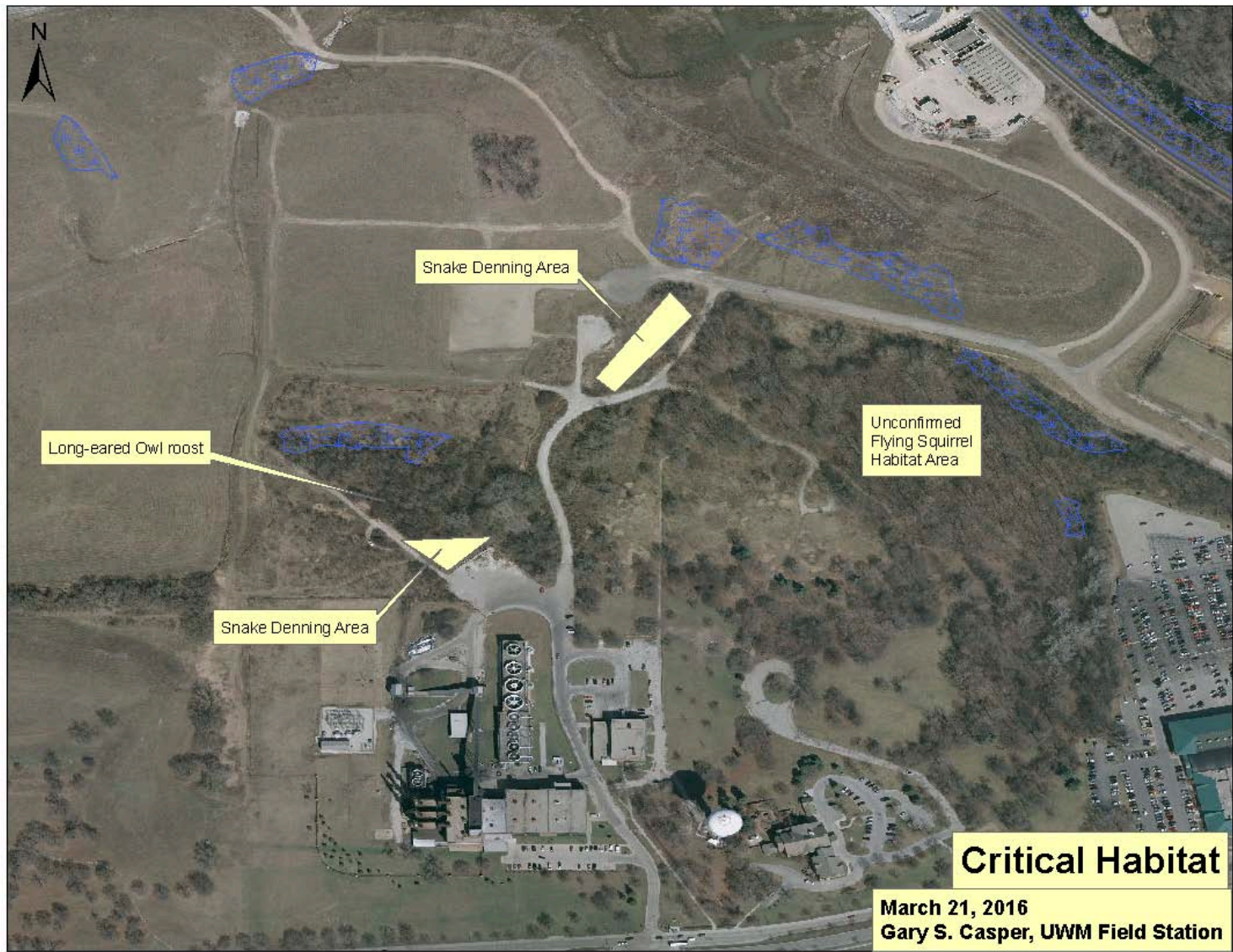


Figure 1: Critical Habitat

Figure 2. Milwaukee County Grounds Critical Species Habitat

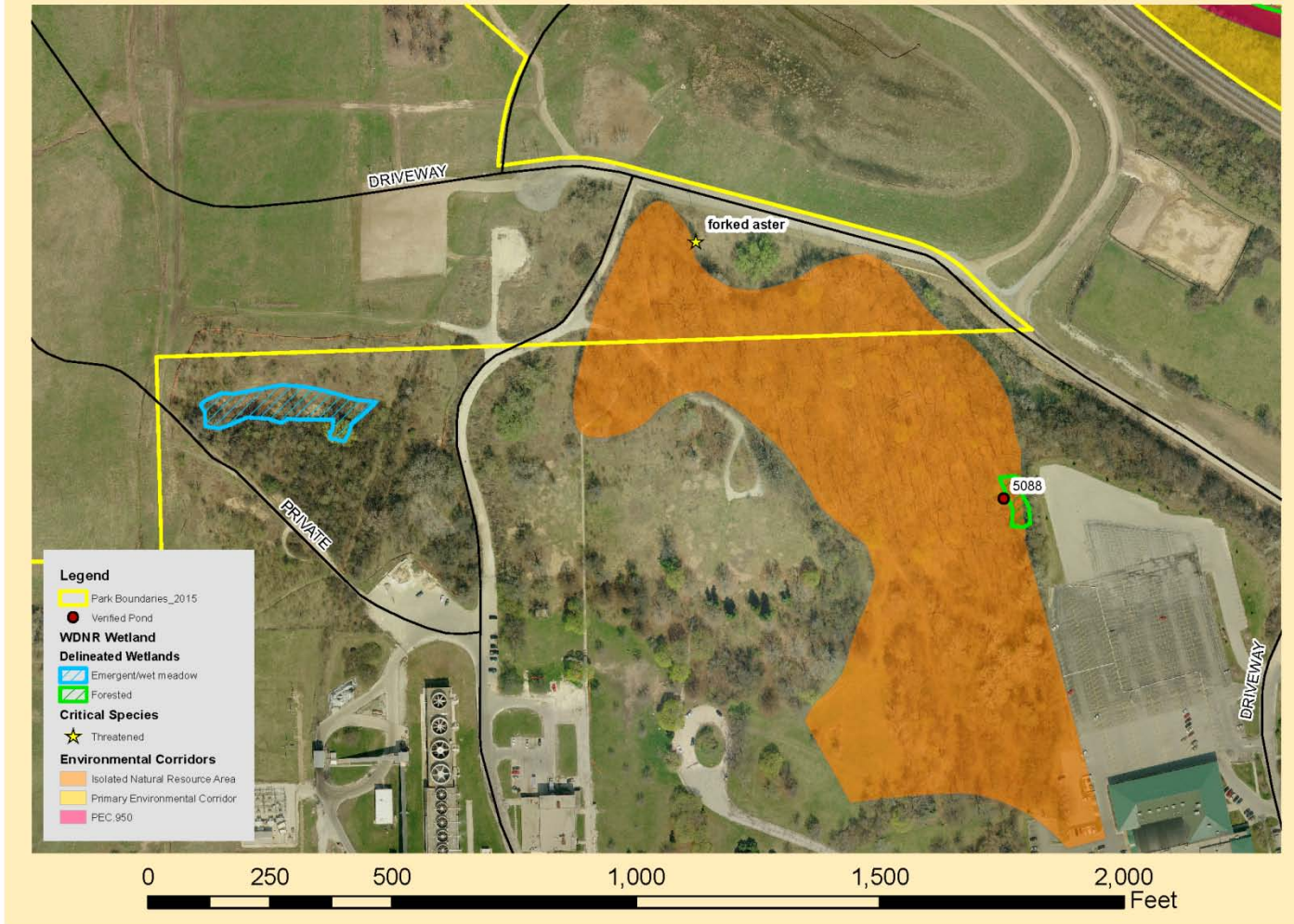


Figure 2: Critical Habitat

1 By Supervisor Weishan, Jr.

File No. 16-

2
3
4 **A RESOLUTION**

5
6 Requiring an informational report on the environmental impacts of constructing a newly
7 proposed parkway on the Northeast Quadrant of the County Grounds, to be prepared
8 and presented to the Board of Supervisors by the Department of Parks, Recreation and
9 Culture in consultation and collaboration with recognized experts in the field of
10 environmental science, such as from the University of Wisconsin-Milwaukee, and with
11 representatives of interested community organizations.
12

13
14
15
16 WHEREAS, the Milwaukee County Grounds is home to various natural wildlife
17 and their habitats; and

18
19 WHEREAS, there is a substantial portion of designated parkland on the County
20 Grounds and the Southeastern Wisconsin Regional Planning Commission (SEWRPC)
21 has designated adjacent portions, including a Department of Natural Resources-
22 designated wetland, that contain critical species habitats as isolated natural resource
23 areas; and
24

25
26 WHEREAS, the City of Wauwatosa has recently circulated a draft of a proposed
27 Wauwatosa Quadrant Master Plan that contains recommended land use improvements
28 and developments in parcels of land on the County Grounds; and
29

30 WHEREAS, as part of the suggested improvements included in this quadrant
31 plan, the construction of a newly proposed "Emerald Parkway" is included to be installed
32 north of Watertown Plank Road and south of North Swan Boulevard, to extend eastward
33 from the existing roundabout on Discovery Parkway, which overlaps with the parcels of
34 land that belong to UWM; and
35

36 WHEREAS, if the proposed Emerald Parkway is constructed as it's currently
37 projected, it would intersect through the isolated natural resource area designated by
38 SEWRPC as a critical species habitat site, which could potentially impact a number of
39 rare and ecologically important species and existing stormwater management
40 infrastructure; and
41

42 WHEREAS, Milwaukee County has a responsibility to closely monitor any
43 proposed or ongoing activity that could potentially impact the environmental balance of
44 County natural land, and other land stakeholders should be aware of all plans for future
45 land use; and
46

47 WHEREAS, Milwaukee County’s previous sale of adjoining property to UWM
48 Real Estate Foundation was contingent upon preserving certain critical wildlife habitat
49 areas as identified by a collaborative task force, providing a clear and rational precedent
50 for any further development of the Northeast Quadrant; and

51
52 WHEREAS, although no formal action has yet been taken by the City of
53 Wauwatosa to implement the proposed Wauwatosa Quadrant Master Plan, it is prudent
54 for Milwaukee County to be proactive in assessing any potential environmental
55 outcomes that may occur as a by-product of future land development; now, therefore,
56

57 BE IT RESOLVED, that the Department of Parks, Recreation, and Culture is
58 requested to collaborate with representatives from both the UWM Conservation and
59 Environmental Sciences and the Friends of the Monarch Trail group to collectively
60 produce an assessment report on the potential environmental impact and scope of work
61 that may result from the construction of the “Emerald Parkway” as proposed in the most
62 recent draft of the Wauwatosa Quadrant Master Plan; and

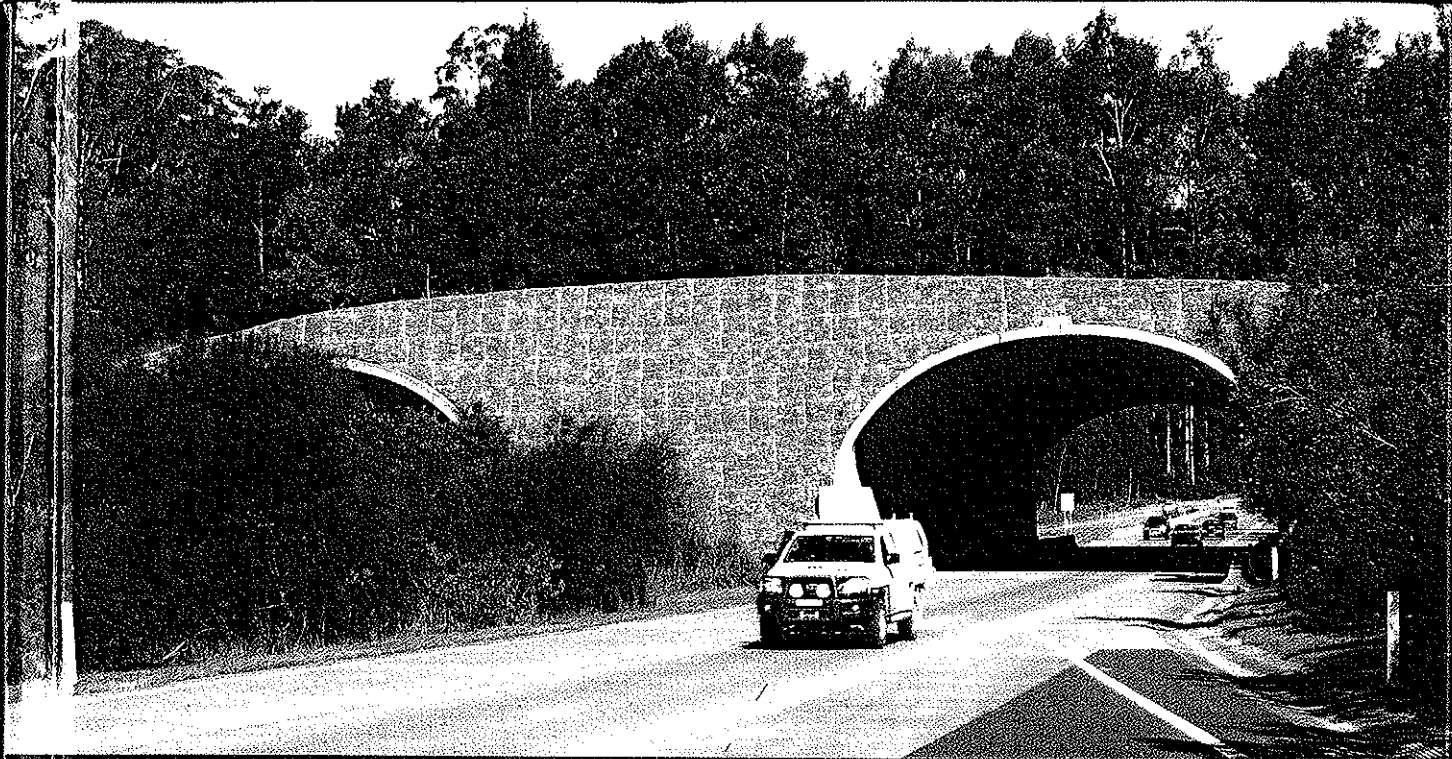
63
64 BE IT FURTHER RESOLVED, that the following questions should be answered
65 within the findings of the requested assessment report:
66

- 67 • What would be the impact to the effectiveness of the existing stormwater
68 management systems and how much additional stormwater management
69 would need to be installed if Emerald Parkway and the proposed
70 surrounding development are constructed?
71
- 72 • What would be the impacts to the existing natural species habitats is
73 Emerald Parkway is constructed.
74
- 75 • What would be the impact to Wauwatosa’s current Tax Incremental
76 Financing (TIF) mechanism? Will it expand to allow for the construction of
77 the proposed parkway? How would it affect Milwaukee County?
78
- 79 • Has the City of Wauwatosa completed rezoning parkland areas within the
80 County Grounds? What is the municipal zoning status of the land on the
81 County Grounds?

82 ; and

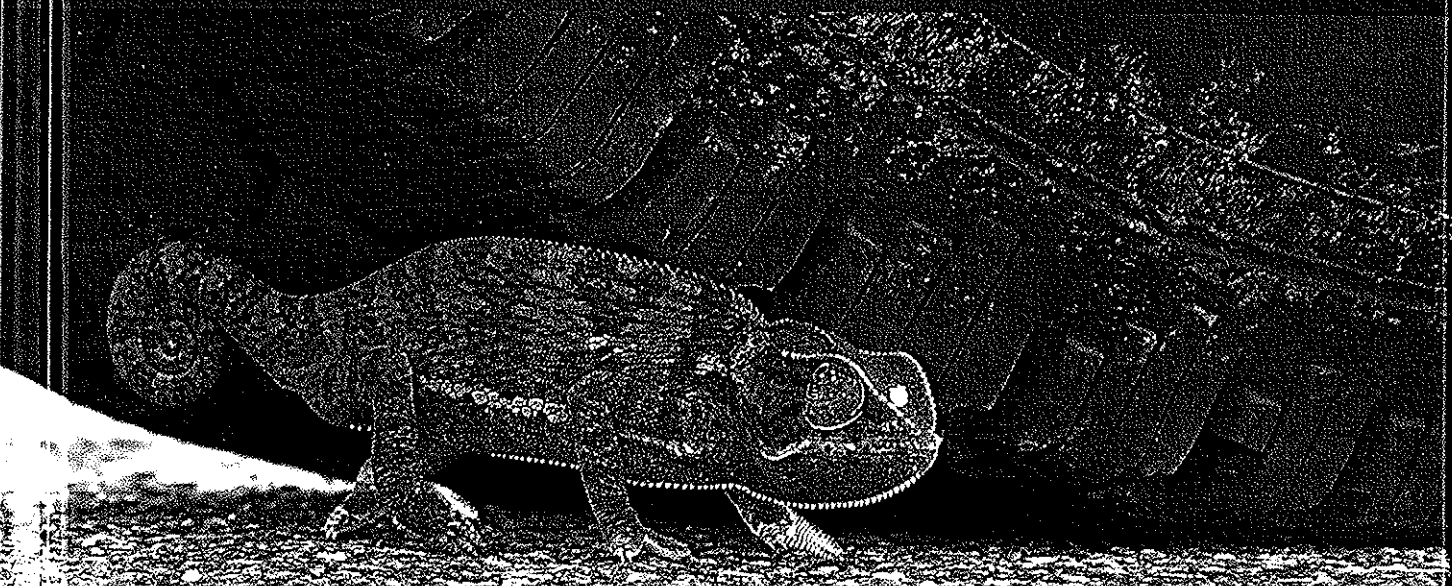
83
84 BE IT FURTHER RESOLVED, that the report should also include a detailed map
85 that specifically outlines which parcels are County-owned land, and which parcels are
86 privately-owned land on the County Grounds; and
87

88 BE IT FURTHER RESOLVED, that this report should be submitted to the County
89 Board no later than the March 2017 cycle.



HANDBOOK OF ROAD ECOLOGY

Rodney van der Ree • Daniel J. Smith • Clara Grilo



WILEY Blackwell

UNDERSTANDING AND MITIGATING THE NEGATIVE EFFECTS OF ROAD LIGHTING ON ECOSYSTEMS

*Bradley F. Blackwell, Travis L. DeVault and
Thomas W. Seamans*

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SUMMARY

Natural light plays an integral role in biological systems, one that can be disrupted by the intrusion of other light sources. Specifically, artificial lighting, including road lighting, poses negative effects on plant and animal physiology, animal behaviour and predation rates. These effects are cumulative as multiple, artificial light sources contribute.

- 18.1** Light functions as a natural stimulus.
- 18.2** Metrics used to quantify artificially produced light are generally not biologically relevant.
- 18.3** Species response to artificial light varies by visual system.
- 18.4** Light emitted varies relative to the type of lighting technology.
- 18.5** Planning for road lighting must include zoning relative to light levels and light-fixture placement.
- 18.6** Mitigating the negative effects of road lighting requires research collaboration.

Negative effects of artificial lighting, including road lighting, are manageable. By better understanding the ecosystems through which roads pass and how light affects resident organisms, we can adapt lighting fixtures, fixture design and zoning to minimise site-specific effects, as well as contributions to cumulative light pollution.

INTRODUCTION

A critical aspect of road planning involves driver and pedestrian safety, and road lighting is a key component (IDA/IES 2011). However, decisions on how, where and when to use artificial lighting have immediate implications for the well-being of ecosystems through which roads pass. Specifically, light is a natural stimulus that affects the physiology, behaviour and movements of all organisms. Artificial lighting alters the length of natural photoperiod (duration of daily exposure to light) and contrasts in intensity and spectrum with natural, ambient light, thus unavoidably affecting the sensory ecology of organisms. Further, artificial light poses cumulative effects on ecosystems because multiple light sources are often present in a given area (Fig. 18.1). Cumulative effects are expressed differentially across species, because not all light sources are equal in their effects on physiology or behaviour.

To mitigate negative effects to natural systems by artificial lighting used on roads, planners must first consider whether lighting is necessary. If so, they must consider not only the varying sensitivity of the human eye to different light wavelengths relative to driver and pedestrian safety but also the biological relevance of lighting to the resident organisms. Our goal is to provide road practitioners, engineers and ecologists with a concise review of resources

available to aid in the reduction of the negative effects of road lighting on ecosystems.

LESSONS

18.1 Light functions as a natural stimulus

Light exists as particles (photons) and waves and is described relative to wavelength (Fig. 18.2). Natural light plays a significant role in the sensory ecology of animals, particularly with regard to photoperiod, which stimulates (i) circadian rhythms important to the basic health and development of plants and animals (e.g. growth, reproduction and disease resistance) and (ii) daily and seasonal physiology and behaviour of animals (e.g. foraging, breeding, dispersal and migration). In addition, animals use light cues in predator detection, habitat selection and vehicle avoidance (Gaston et al. 2012, 2013).

18.2 Metrics used to quantify artificially produced light are generally not biologically relevant

Consideration given to design of light fixtures and emission spectra (i.e. the distribution of wavelengths emitted by a lamp; Fig. 18.2) generally fails to consider the



Figure 18.1 Multiple light sources, including road lighting, from Dubai, UAE, contributing to cumulative artificial light pollution. Photograph credit: Expedition 30 Crew to the International Space Station for the Earth Observations Experiment and Image Science & Analysis Laboratory, Johnson Space Center; U.S. National Aeronautics and Space Administration (<http://earthobservatory.nasa.gov/IOTD/view.php?id=77360>). Source: Photograph from Earth Observatory, NASA.

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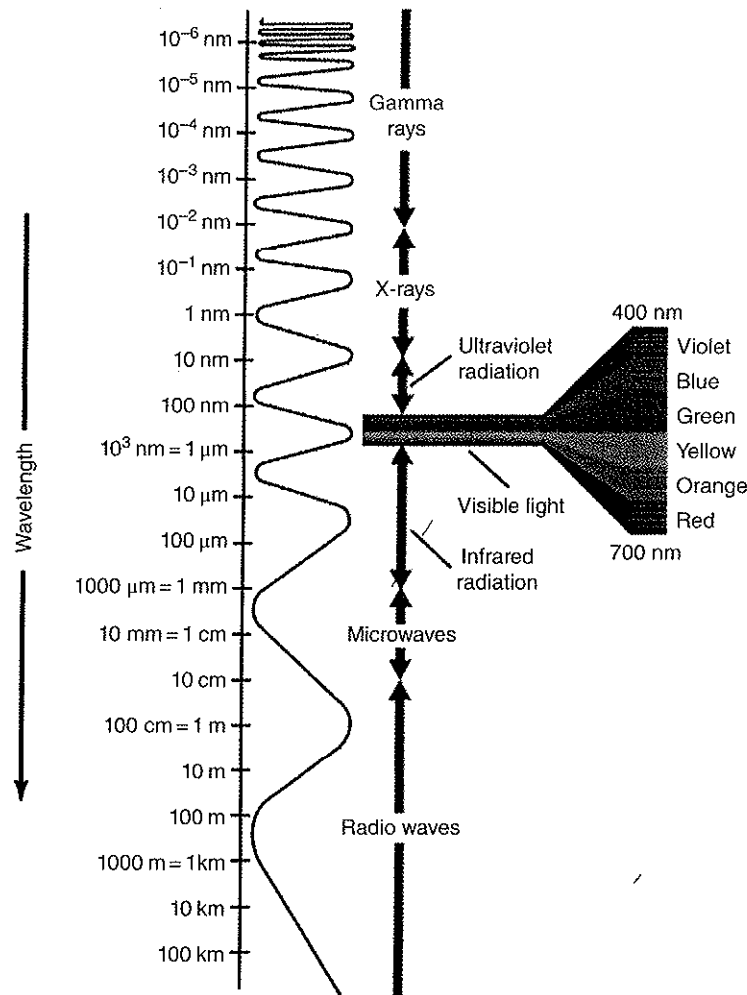


Figure 18.2 The electromagnetic spectrum and the portion of the spectrum visible to most animals, represented in nanometres (nm or 1×10^{-9} m) from 400 to 700 nm. Notably, many non-primate species of animals have the capability to detect wavelengths in the near ultraviolet (300–400 nm). Figure credit: U.S. National Aeronautics and Space Administration; http://science-edu.larc.nasa.gov/EDDOCS/Wavelengths_for_Colors.html. Source: NASA.

biological relevance of the light stimulus. For example, light emitted from artificial sources is typically not quantified relative to wavelength, but in lumens (i.e. the luminous flux or power from a light source) and illuminance (the total luminous flux incident on a surface per unit area). However, we cannot effectively understand animal response to light stimuli if the measurements (metrics) of fixture design and performance are in units of power.

Plants and animals respond directly to the intensity or number of photons per wavelength striking

photoreceptors in their eyes (Endler 1990; Rich & Longcore 2006; Gaston et al. 2013). For example, 1 W of light at 400 nm (Fig. 18.2) has only 57% of the photon flux as 1 W of light at 700 nm (Endler 1990). In other words, the total energy reported is 1 W at both wavelengths, but the biologically relevant metric, photon flux by wavelength, differs by greater than 50%. As such, the lumen and luminous flux are inaccurate metrics for discerning biological effects because they do not take into account the density of photons striking photoreceptors. We suggest that light fixtures

and potential effects on organisms be evaluated relative to emission spectra and biologically relevant light intensity within the area of incidence (i.e. the area illuminated). This task will require collaboration among planners, lighting engineers and ecologists (Lesson 18.5). As for actual measurements, these should be taken via spectroradiometer.

18.3 Species response to artificial light varies by visual system

Effective planning for road lighting should consider how light affects organisms in roadside habitats. Fortunately, recent research (e.g. Rich & Longcore 2006; Horváth et al. 2009; IDA 2010; Gaston et al. 2013) details the negative effects of artificial lighting on various species and ecosystems. In short, planning for road lighting relative to potential biotic effects must consider that relative brightness of artificial light and effects of emission spectra on organisms vary with the sensory (plants) and visual physiology of the animals affected.

For example, human vision is trichromatic, meaning that we possess three independent channels for detecting and processing colour. However, many non-primate animals perceive the world in a much different way. Birds are generally tetrachromatic and capable of detecting wavelengths within the ultraviolet portion of the electromagnetic spectrum (Hart 2001; Fig. 18.2), whereas few bird species rely on scotopic or rod-dominated vision (i.e. rod photoreceptors are primarily sensitive to light intensity, such as under dim-light conditions). Further, the ability to perceive colour is dependent on the number of different visual pigments present in cone photoreceptors.

The influence of natural light is evident with changes in photoperiod that influence the timing of seasonal events in birds (e.g. effects on breeding physiology) and even mate selection (Dawson et al. 2001; de Molenaar et al. 2006). The addition of artificial light can interfere with this natural stimulus (de Molenaar et al. 2006). Also, a light-sensitive 'magnetic compass' aids orientation during night-time migration (especially when cloud cover prevents the use of stars as visual cues); this innate navigational ability can be confounded by specific wavelengths from artificial lighting (e.g. >500 nm; Poot et al. 2008).

Perhaps the most well-known effect of artificial light on birds is the attraction to, and disorientation by, high-intensity glare from warning beacons on communication towers, offshore oil platforms and other structures (Gauthreaux & Belser 2006). Birds migrating at night and attracted to such lighting can become 'trapped by

the beam' (Verheijen 1985) and subsequently die from direct collisions with structures or other birds or indirectly by depletion of energy reserves expended while flying towards or around artificial lights. Bird attraction to artificial lights is more pronounced on cloudy and misty nights than clear nights (Montevocchi 2006). Artificial lighting can also affect the quality of breeding habitat and timing of breeding (de Molenaar et al. 2006), prey availability (Negro et al. 2000), singing patterns (Miller 2006) and foraging and potentially increase exposure to predators by drawing birds to artificially lit areas (Santos et al. 2010). However, the primary negative effect of road lighting on birds is the contribution to cumulative light pollution of reflected or escaping light skywards from multiple light sources (Fig. 18.1) (light that interferes with detection of celestial migration cues), a problem that can be managed by fixture design (Lesson 18.4; Fig. 18.3) and zoning (Lesson 18.5).

In contrast, the visual capability of bats is primarily rod dominated, and species response to road lighting varies by level of illumination and area affected (Lesson 18.5). Foraging opportunities for bats can be enhanced due to insect attraction to light (Eisenbeis 2006; Lesson 34.3), but increased competition with other bat species and avoidance of lighting can also pose negative effects (Rydell 2006; Zurcher et al. 2010; Stone et al. 2012). Bats attracted to road lighting are also susceptible to vehicle collisions (Zurcher et al. 2010; Chapter 34). For the most part, however, effects of road lighting on bat species are manageable via attention to light-fixture location, lamp illuminance and shielding (Fig. 18.3; Lessons 18.4 and 18.5).

Similarly, other terrestrial mammal species (e.g. rodents) are also susceptible to disruption in photoperiod and migration, as well as enhanced predation associated with artificial lighting. As with bats, light-fixture location, lamp illuminance and shielding (Lessons 18.4 and 18.5) can be adapted to the particular species affected by road lighting (see Rich and Longcore (2006) for detailed discussion of artificial lighting effects on terrestrial mammals).

Few studies have examined the effects of road lighting on amphibians and reptiles or reported biologically relevant metrics of light intensity for these species or other taxa (Perry et al. 2008). An exception is the well-documented negative effect of artificial lighting on sea turtles (Salmon 2006). Also, as with birds, the magnetic compass in amphibians is affected by light wavelengths greater than 500 nm (Diego-Rasilla et al. 2010), a spectral range falling within that of sodium-vapour lamps often used along roads (Rydell 1992). An effective management approach to reduce negative effects of road

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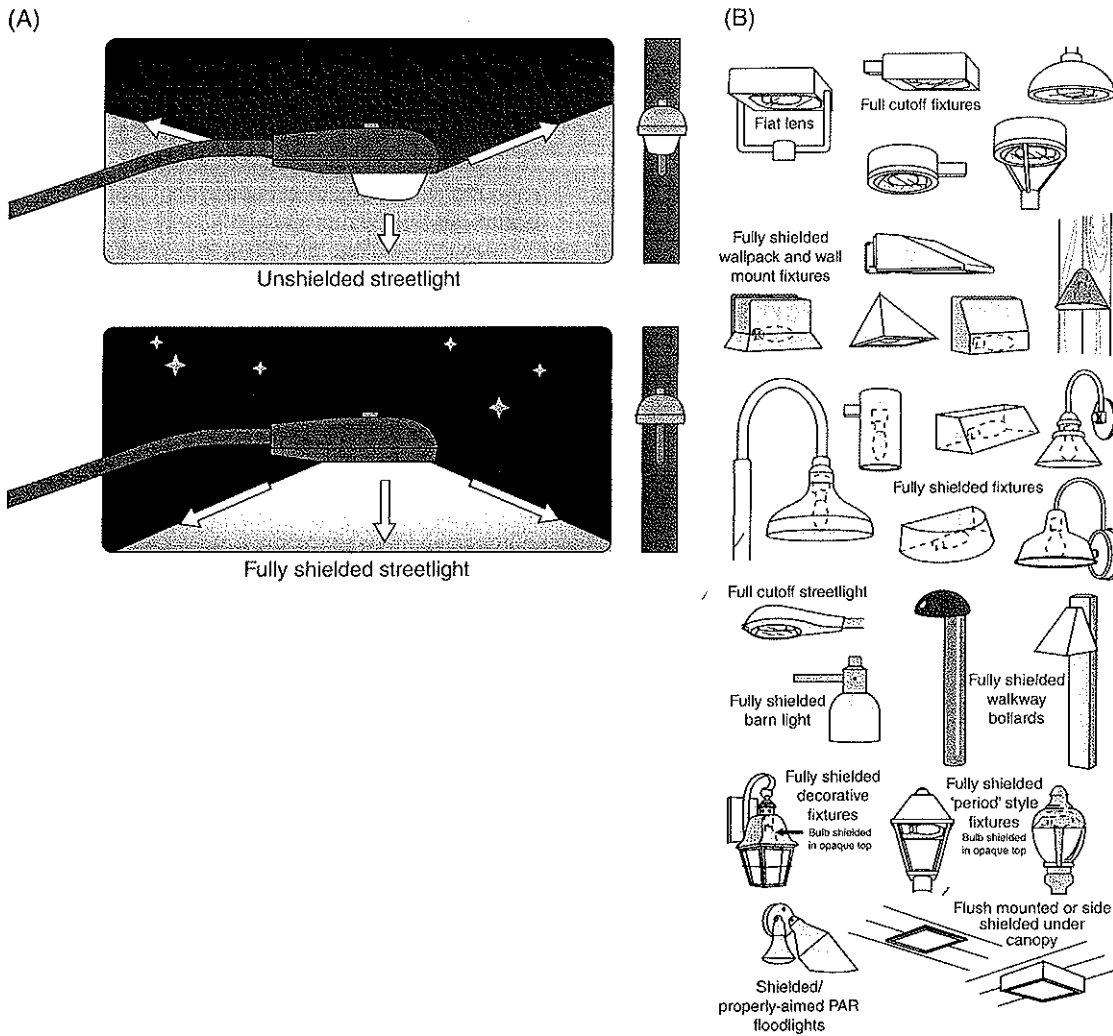


Figure 18.3 (A) Unshielded and shielded light showing light escaping. (B) Examples of fully shielded lamp fixtures intended for structures as well as road applications. Source: Reproduced with permission of R. Crelin (www.BobCrelin.com).

lighting on amphibians and reptiles includes species-specific considerations relative to light-fixture location, position above or in the road (i.e. road-embedded lighting), emission spectra and intensity, shielding (Fig. 18.3) and on/off schedules (Lessons 18.4, 18.5 and 18.6).

18.4 Light emitted varies relative to the type of lighting technology

Current options for selection of road lighting technology include standard high-intensity discharge sources (a lamp technology with emission from 550 to 650 nm;

Rich & Longcore 2006; Fig. 18.2) and the more recently introduced solid-state light-emitting diodes (LEDs), often marketed as 'cool white' LEDs. Despite the name (associated with how humans perceive light from these devices), energy emitted by these LEDs commonly include wavelengths from 450 to 460 nm, thus falling into the blue range of the electromagnetic spectrum (IDA 2010; see also Gaston et al. 2012; Fig. 18.2). Advocates of these devices contend that they afford lower illumination levels because of the sensitivity of human rod cells to shorter wavelengths (IDA 2010; Falchi et al. 2011). However, caution is recommended when considering widespread use of this lighting.

Unnatural levels of exposure to wavelengths less than 500 nm can pose far greater deleterious effects on animals, including humans (e.g. disruption in circadian rhythms and metabolic function), than sources with emissions greater than 500 nm (IDA 2010; Falchi et al. 2011; Gaston et al. 2012).

In addition, lamp type also influences fixture temperature which, with emission spectra, contributes to insect attraction, as well as energy required for full illumination (Eisenbeis 2006). Attraction of invertebrate prey can influence foraging and imbalanced competition among bat species (Stone et al. 2012), as well as increased mortality to some insect species (Eisenbeis 2006).

18.5 Planning for road lighting must include zoning relative to light levels and light-fixture placement

Questions that should be asked during road planning include: What level of illumination is required, if any? How would planned lighting contribute to cumulative artificial light pollution within an ecosystem? What emission spectra would pose fewer direct negative consequences to species exposed to lighting? How might lighting indirectly affect animals by attracting and concentrating prey? How might light-fixture design, zoning and placement help reduce negative effects on organisms? Typically, recommended light-fixture type, area of effect and cumulative illumination by road lighting vary by human population density, level of human activity and the interspersed of protected natural areas.

The IDA/IES (2011) provides zoning guidance to balance illumination relative to the needs of people and ecosystems adjacent to the road, though guidance is not specific to biological light intensity. Within specified zones, and considering the type of site (e.g. road through residential or non-residential area), the IDA/IES recommends Total Initial Luminaire (TIL; lumens per site) and Maximum Allowable Backlight, Uplight and Glare (i.e. 'BUG') ratings. Essentially, each zone and associated TIL/BUG rating represents a broad approach to mitigating effects of light pollution. In addition, fixture orientation and shielding (also affecting the TIL/BUG rating) should limit upward incidental reflection or direct emission so as to reduce light escaping skywards (Fig. 18.3), which contributes to skyglow and attraction of insects or migrating birds (Eisenbeis 2006; Salmon 2006; Luginbuhl et al. 2009; Falchi et al. 2011; IDA/IES 2011). The IDA/IES (2011), in particular, provides a

thorough summary of application type, fixture/lamp designs, associated metrics describing light properties and guidance on zoning and BUG ratings.

18.6 Mitigating the negative effects of road lighting requires research collaboration

Ultimately, effective mitigation of the effects of road lighting on ecosystems requires communication among road planners, lighting engineers and ecologists. An example of such collaboration is an advance in lighting technology that allows for complete elimination of traditional overhead road lighting where the intent is for driver orientation and not roadside illumination. Specifically, Bertolotti and Salmon (2005) and Salmon (2006) showed that road-embedded LEDs along Highway A1A in Boca Raton, Florida, United States, prevented stray light from reaching nearby beaches, thus reducing the nocturnal disorientation of dispersing sea turtle hatchlings. In addition, we suggest that future research in the development of lighting technology and application consider (i) light-fixture performance measured in terms of biologically relevant light intensity; (ii) lamp designs that are easily adaptable to wavelength and intensity requirements; and (iii) daily and seasonal scheduling for operation relative to the ecosystem affected.

CONCLUSIONS

Depending upon concerns for driver or pedestrian safety, an obvious solution to managing negative effects of road lighting in conservation areas is to avoid the use of road lighting altogether. However, where lighting is deemed necessary, it is also important to recognise that a 'one-size-fits-all' approach to road lighting will not minimise negative effects to ecosystems. Collaboration among planners, lighting engineers and ecologists will allow for the tailoring of lighting technology that maximises driver and pedestrian safety while reducing or eliminating the effects of artificial light on ecosystems. Where data on wavelength sensitivity of affected taxa are unavailable, we suggest that a conservative approach is to reference findings from taxonomically related species. These findings might include behavioural responses to biologically relevant measures of emission spectra or to light measured at levels of luminous flux (see Gaston et al. (2013)). Another option is to make conservative decisions on

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lighting (e.g. avoiding emission spectra <500 nm; see Lesson 18.4). We also concur with Falchi et al. (2011) that where artificial lighting is necessary, these sources should (i) not release light directly at and above the horizontal; (ii) limit downward emission outside the area to which lighting is required; (iii) limit emission of short-wavelength spectra; (iv) be zoned and spaced to minimise unnecessary lighting; and (v) be operated via on/off scheduling where appropriate.

ACKNOWLEDGEMENTS

During the preparation of this chapter, the authors were supported by the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center (NWRRC). We thank E. Poggiali (NWRRC) for assistance with manuscript preparation.

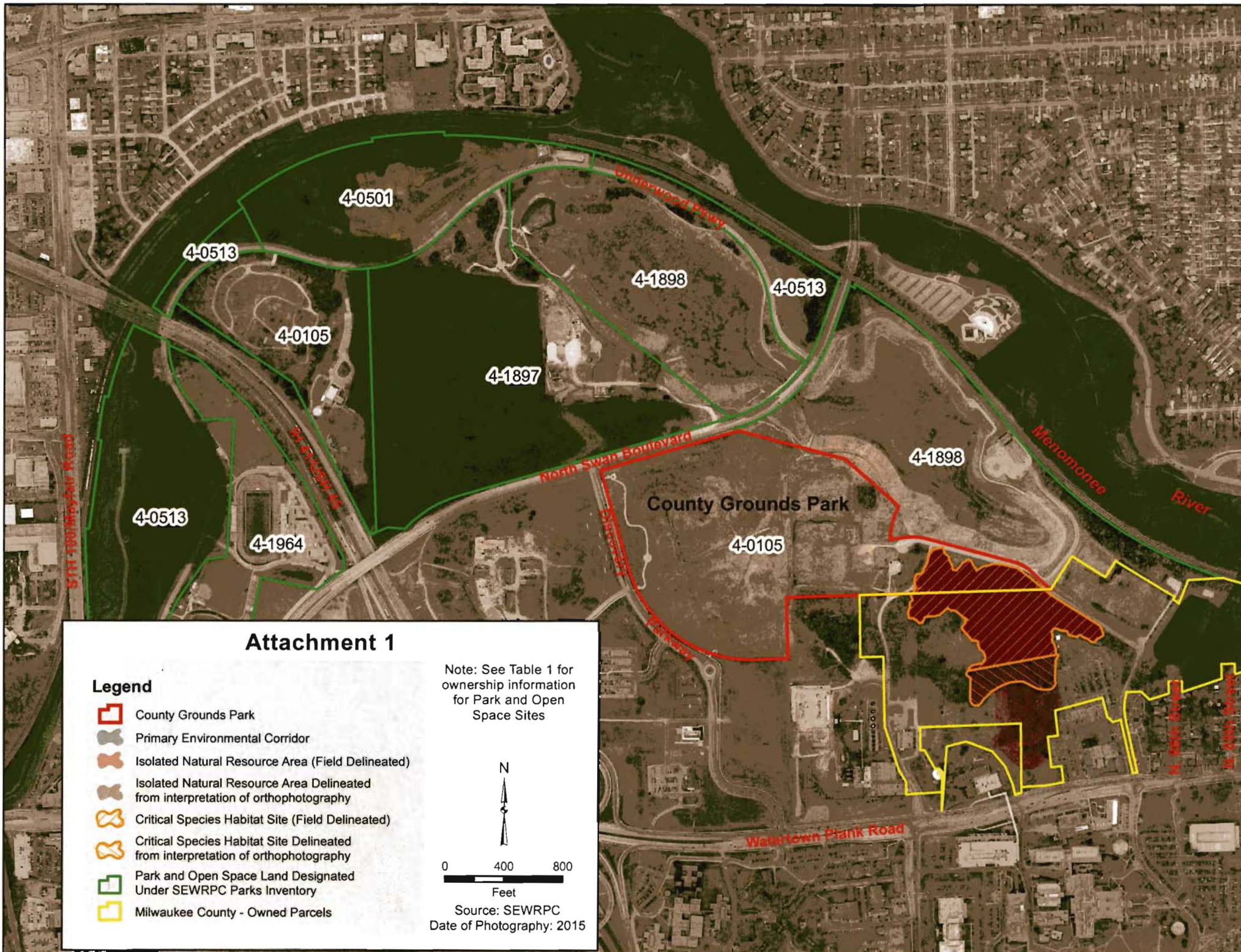
FURTHER READING

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- Gaston et al. (2013): Proposed a framework for consideration of how artificial lighting alters natural light regimens and influences biological systems.
- Rich and Longcore (2006): Published the first detailed assessment of the negative consequences of artificial night lighting on ecosystems.

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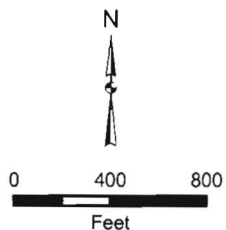


Attachment 1

Legend

-  County Grounds Park
-  Primary Environmental Corridor
-  Isolated Natural Resource Area (Field Delineated)
-  Isolated Natural Resource Area Delineated from interpretation of orthophotography
-  Critical Species Habitat Site (Field Delineated)
-  Critical Species Habitat Site Delineated from interpretation of orthophotography
-  Park and Open Space Land Designated Under SEWRPC Parks Inventory
-  Milwaukee County - Owned Parcels

Note: See Table 1 for ownership information for Park and Open Space Sites



Source: SEWRPC
Date of Photography: 2015

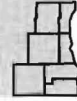
SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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July 7, 2016

Ms. Barb Agnew
Friends of the Monarch Trail
12326 W. Watertown Plank Road
Wauwatosa, WI 53226

Dear Ms. Agnew:

This is to respond to your May 26, 2016, electronic mail message and our telephone conversation of that same day. You noted the Commission staff had identified an isolated natural resource area (INRA) in the northeast quadrant of the IH 41/USH 45 and Watertown Plank Road interchange, and you requested that the Commission staff provide you with a map or aerial photograph which would show the boundaries of that area.

Attachment 1 to this letter shows a 21.4-acre INRA as identified by the Commission staff. In general, an INRA is a relatively small pocket of wetlands, woodlands, surface water, or wildlife habitat that is isolated from environmental corridors by urban development or agricultural use, and which has significant value despite being separated from the environmental corridor network. This specific area was determined to be an INRA because it is over five acres in area and at least 200 feet wide and consists of upland woods, significant wildlife habitat, areas of steep slope, and a critical species habitat site informally known as the County Grounds Woods.

As indicated on Attachment 1, the boundary of the northern portion of the INRA was field delineated by the Commission staff in 2005 at the request of a consultant for the Milwaukee Metropolitan Sewerage District. The boundary was transferred to an orthophotograph and digitized by Commission staff. The southern portion of the INRA was delineated based on interpretation of digital orthophotographs obtained by Milwaukee County under a program administered by the Commission. The entire INRA is located on land owned by Milwaukee County.

As noted above, the INRA contains a 14.6-acre critical species habitat site designated by the Commission staff (see Table 10 in the December 2010 *Amendment to the Natural Areas and Critical Species Habitat Protection and Management Plan for the Southeastern Wisconsin Region*). The critical species habitat site was designated based on the presence of *Aster furcatus* (forked aster), a threatened plant species in the State of Wisconsin. The critical species habitat site as shown on Attachment 1 was delineated on an orthophotograph based on field observations of the extent of the area with characteristics that could support forked aster.

The Regional Planning Commission has long recommended that primary environmental corridors be preserved in essentially natural, open space uses and that, as county and local governments conduct their land use and park and open space planning, they consider the preservation of secondary environmental corridors and isolated natural areas in essentially natural open use. The Commission has acknowledged that some development may be compatible with environmental corridors and INRAs as set forth in the attached Table 27 from SEWRPC Planning Report No. 48, *A Regional Land Use Plan for Southeastern*

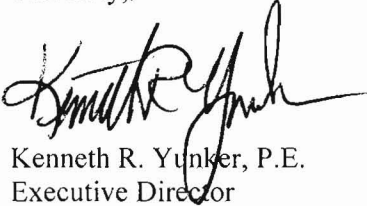
Ms. Barb Agnew
Page 2
July 7, 2016

Wisconsin: 2035, June 2006. Although some transportation, utility, and recreational development may be compatible with environmental corridors and isolated natural resource areas, as indicated in Table 27, those are generally not compatible uses within critical species habitat sites.

Attachment 1 shows park and open space sites designated under the SEWRPC parks inventory and primary environmental corridors in the vicinity of the subject INRA. We would note that the lands included in the County Grounds Park to the east of Discovery Parkway and south of N. Swan Boulevard are not designated as primary environmental corridor or INRA.

We trust that the foregoing information will be useful to you. Please contact us if you have questions or comments.

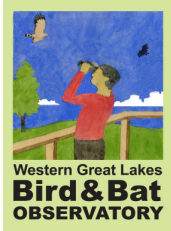
Sincerely,



Kenneth R. Yunker, P.E.
Executive Director

KRY/MGH/dd
#232298

Enclosures



Western Great Lakes Bird & Bat Observatory

4970 Country Club Road
Port Washington, Wisconsin 53074

January 30, 2017

Dear Chris Abele, Milwaukee County Executive, Milwaukee County Courthouse 901 N. 9th Street, Room 306 Milwaukee, WI 53233

Milwaukee County Board of Supervisors, Milwaukee County Courthouse 901 N. 9th Street, Room 201 Milwaukee, WI 53233

City of Wauwatosa, 7725 W. North Avenue Wauwatosa, WI 53213

RE: Potential development of Sanctuary Woods/East Woods at the Milwaukee County Grounds

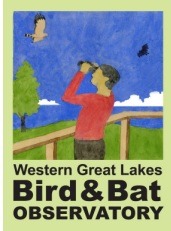
Dear policy makers:

I am writing on behalf of the Western Great Lakes Bird and Bat Observatory. Development of the Milwaukee County Grounds potentially threatens the remaining wildlife habitat found there, which is critical to many migratory birds and invertebrates, plus several species found there during the winter season.

Existing high-quality wildlife habitat in southeastern Wisconsin is disappearing in many areas, and protection of those parcels that remain is of increasing importance. I could list many valuable and iconic species such as the monarch butterfly, for which habitat has been up until now protected at the county grounds. However, one species of high interest in this context is the Long-eared Owl, a state Species of Special Concern, which has winter roosts on the County Grounds. Long-eared Owl is a perfect example of a "sensitive species", which is very subject to disturbance by humans, is likely experiencing regional population declines, and for which secure wintering areas are at a premium. Development of the County Grounds would disrupt this wintering site, and other suitable locations may be at a great distance, placing these birds at risk during the time of year when stress caused by harsh weather conditions, low prey availability, high levels of human disturbance (see reference below) , and potential nocturnal vehicle collisions are already-existing sources of population limitation, and resulting deleterious effects on the County Grounds birds.

In addition to the above concerns, the placement of extensive bright lighting throughout the proposed development may also have deleterious effects on a variety of wildlife species, including breeding and migratory birds. (See reference below).

Please reconsider your development plans for this high-quality natural area, until a full environmental assessment by qualified scientists is complete.



Western Great Lakes Bird & Bat Observatory

4970 Country Club Road
Port Washington, Wisconsin 53074

Resources

Blackwell, B. F., T. L. DeVault, and T. W. Seamans. 2015. Understanding and mitigating the negative effects of road lighting on ecosystems. Online:

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Accessed 15 January 2017

Chace, J. F. and J. J. Walsh. 2006. Urban effects on native avifauna – a review. *Landscape and Urban Planning* 74: 46-69.

Thank you for your consideration.

Sincerely,

William Mueller
Director, Western Great Lakes Bird and Bat Observatory



Bird City Wisconsin

*Making our communities healthy for birds ...
and people*

1111 E. Brown Deer Road
Bayside, WI 53217



picture windows, landscape our yards, and desire the corner office with the best view. Living in communities that have nature close at hand has also been shown to have a positive effect on mental health, not to mention that studies have shown that as the number of birds and trees in an area go up, so do property values. It is safe to say that, if you polled the neighborhoods around the County Grounds, you would find **resounding support** for preserving this wildlife habitat.

The County Grounds are important habitat for a variety of organisms, many of which will disappear if this parcel is developed further. The Grounds have one of the largest bird lists for Milwaukee County's non-coastal urban habitat, with 142 species having been recorded there according to eBird, including: Eastern Bluebird, Belted Kingfisher, Peregrine Falcon, Bobolink, Eastern Whip-poor-will, and Rough-legged Hawk. There is also a winter roost for the magnificent Long-eared Owl at the site, very near the proposed development. It is nearly certain that this species will disappear from the Grounds if the County proceeds with development. This habitat also supports monarch butterflies, reptiles, amphibians, insects, and a wide variety of plants upon which all of these other organisms rely.

For my Ph.D. dissertation I studied the impacts of habitat fragmentation (taking one large habitat and splitting it into several through the addition of roads, clearings, and other human uses). Fragmented habitats are less valuable for most wildlife and significantly less valuable for species that require low disturbance to be successful or even occupy an area. The proposed development will greatly increase habitat fragmentation at the County Grounds and the proposal appears to be the first in a number of future projects that would further fragment the area and destroy its value for sensitive wildlife.

Increased development in the form of new buildings will also lead to an increase in bird mortality due to window collisions. Every year in the United States, 600 MILLION birds die following collisions with windows. Buildings in and near natural areas, like the County Grounds, can be especially problematic given their proximity to a large number of birds. Any added development at the Grounds will definitely increase the number of birds who die after colliding with windows.

I could continue, but I will conclude as I believe you understand my views at this point. The Milwaukee County Grounds are a jewel, a feather in Milwaukee County's cap. This habitat has immense importance for wildlife, increases property values, and is good for the mental health of Milwaukee residents who live near or visit the Grounds. Developing this area will have a negative impact on everything just mentioned, trading all of the above for a small increase in tax revenue that does not come close to compensating for the losses that will follow from the proposed development and the additional projects that are sure to follow it in the future.

I hope that Milwaukee County decides to maintain the spirit of a Bird City High Flyer and protect the County Grounds from development. If you do, the County will be able to continue to tout the value it places on being a green community ... and your residents will certainly thank you for it.

Sincerely,

Bryan Lenz, Director